BY THE COURT: -- before we proceed. Let's take about a ten-minute recess because I know that may be lengthy.

(After a short recess, the following was made of record, to-wit:)

BY THE COURT: Who does the State call as your next witness?

BY MR. HARPER: We call Dr. Stephen Hayne, Your Honor.

BY THE COURT: Dr. Stephen Hayne.

STEPHEN HAYNE,

having been duly and legally sworn, answered questions on his oath as follows, to-wit:

BY THE WITNESS: Good morning, Your Honor.

BY MR. HARPER: May I proceed, Your Honor?

BY THE COURT: Yes, sir.

DIRECT EXAMINATION

BY MR. HARPER:

Q. Would you state your name, please, sir.

A. Stephen Timothy Hayne, sir.

Q. And Dr. Hayne, what is your profession?

A. I'm a physician practicing in the fields of anatomic, clinical, and forensic pathology.

Q. Okay, sir. And do you currently have a position with the state medical examiner's office?

A. I do, sir.

Q. And what is that position?

A. State pathologist with the Department of Public Safety.

Q. How long have you held that position, Dr. Hayne?

A. Approximately seventeen, eighteen years, sir.

Q. How long have you been practicing in the area in the field that you are now practicing in?

A. Almost thirty years.

Q. Dr. Hayne, if you would, tell us your education, experience, and training that qualifies you in that field of forensic pathology.

A. I graduated from medical school at Brown University. I did my pathology training at Letterman Army Medical Center at the Presidio at San Francisco. Rotations at different institutions in the San Francisco Bay area. I worked -- I went to two duty stations. First at Fort Levinworth, Kansas, and Munsen Army Hospital down -- Blachfield Army Hospital at Fort Campbell, Kentucky. I worked in the north Alabama area, the Shoals medical laboratory for two years. I worked in Mississippi for going on some seventeen or eighteen years now. I have been affiliated with the medical examiner's office continuously and also work as senior pathologist at Rankin Medical Center. Worked at other hospitals in the Jackson metropolitan area. I also served as the medical director of the laboratory at Madison County Medical Center and also at the renal laboratories in Ridgeland, Mississippi.

Q. Okay, sir. And as a forensic pathologist, Dr. Hayne, what do you primarily do? What is your primary field? What does that involve?

A. The primary task is to come to conclusions as to the cause and manner of death involving the death of

a human being. That requires most commonly contact with coroners, with other investigative agents. Also performing post mortem examinations or autopsies and attempting to come to conclusions as to cause and manner of death.

Q. Okay, sir. And, Doctor, approximately how many autopsies have you performed since you've been practicing as a forensic pathologist?

A. I don't keep an exact number but about twenty-five thousand.

Q. And obviously a good many of those while you were serving with the state medical examiner's office here in Mississippi?

A. Yes, sir.

Q. And I'll ask you, have you been qualified to testify in court before?

A. Yes, sir.

Q. Approximately how many times?

A. Twenty-five hundred, maybe three thousand times.

Q. Okay, sir. And, in fact, have you been qualified to testify as an expert in the field of forensic pathology right here in this court district and in Adams County before?

A. Yes, sir. In this courtroom.

Q. How many times roughly? I know it's --

A. Ten or fifteen times, sir.

BY MR. HARPER: Your Honor, we would tender Dr. Hayne as an expert in the field of forensic pathology.

BY MR. CLARK: We'll accept him, Your Honor.

BY THE COURT: Let the record show that the Court will accept the witness, Dr. Steven Timothy Hayne, as an expert in the field of forensic pathology. This Court has accepted this witness numerous times in the past in such field, and the Court finds that by virtue of his education, training, experience, skill, and knowledge, that he is so qualified and will be accepted. Now, again, ladies and gentlemen, because he is accepted as an expert witness, he will be allowed to give opinions within his expertise. All right. Mr. Harper, you may proceed.

BY MR. HARPER:

Q. Dr. Hayne, I'd like to direct your attention to an autopsy that -- or to the date, specifically February the twenty -- I believe it was the 22nd of this year, 2002, and ask if you had occasion to perform an autopsy on that date on a six-month old or approximately six-month-old infant child by the name of Chloe Madison Britt.

A. I did, sir. And the --

Q. Okay, sir --

A. -- autopsy started at 6:50 in the evening. The autopsy was requested by the county coroner medical examiner investigator of this county, the county of jurisdiction. Mr. Lee requested that, and that request was in compliance with the Coroner's Reorganization Act of 1986 Amended.

Q. Okay, sir. And if you would, Dr. Hayne, just

tell us briefly -- or what an autopsy entails for the jury and for myself. What exactly you're talking about when you're doing an autopsy on someone and what your purpose for doing that is.

A. An autopsy or post mortem examination is essentially defined by the term autopsy. Auto opsis, I see, I observe, I look. The primary purpose is to come to a conclusion as to the cause and manner of death. The cause of death being the medical reason an individual died, whether it be from a heart attack or gunshot wound or literally thousands of possibilities. While the manner of death is a classification of that death, whether it be suicide, homicide, accident, natural, some cases pending to additional information is gathered, and in rare cases, undetermined. When one cannot come to a final conclusion. An autopsy is an examination of a body, and the initial step is not actually looking at the body but receiving information concerning the death from the submitting officer, in this case, Mr. Lee. That's followed by an external examination, looking at the external surfaces of the body, and always focusing on any aspect that may be associated with the cause of death and the manner of death. There is collection of evidence appropriate to that step. Photographic documentation. I use body illustration diagram sheets to document, the pieces of paper, the findings that I'm observing, their locations, and extent and size. That's followed by, then, an internal examination, looking at the body organs after opening the body. Looking at the head, looking at the

scalp, looking at the contents of the chest and abdominal cavities to see if there's any evidence of injury or disease at those locations, as well as collecting evidence appropriate to that step of the examination. It's followed after completion of that with a discussion of the case with the submitting officer. Again, in this case, Mr. Lee, county coroner medical examiner investigator. Then a microscopic review of the tissues is performed. Small segments of tissue are removed, and they are reviewed under a microscope, and ultimately, if other information is required, other agencies may be asked to do certain procedures. To assist in the generation of the final document. The cause and manner of death, the two most important aspects of that document, and by the rules of the attorney general of this state, the individual performing a post mortem examination under the coroner's office through the medical examiner's office must generate a written report, must summarize the pertinent findings, and also must come to a conclusion as to the cause of death and the manner of death.

Q. Okay, sir. And just to clarify. As I understand what you are saying, Doctor, you examined the body, but your primary focus is to what the cause of death was and in examining it, you pretty much concentrate on that primarily. Would that be safe to say?

A. The examination of the body is focused driven. It is essentially to assist an individual in coming to a conclusion as to cause of death and manner of death.

Q. You might make observations about the body and

about other things, about other significant things but the most significant thing and what you're looking for is what caused the death?

A. Cause of death and then the classification of that death.

Q. Okay.

A. The medical reason that that individual died as well as the classification of the death into one of six possibilities.

Q. Okay, sir. And referring back to the individual, the child, Chloe Madison Britt, did you, in fact, do those things in your autopsy with her?

A. I did, sir.

Q. Okay. Would you tell us about your autopsy. What you were able to find and what your examination showed you of Chloe Madison Britt.

A. On the external examination, there were injuries consisting predominantly of bruises or contusions medically. They were located over the forehead at several sites, measuring up to approximately one inch individually. There was also a bruise located on the back of the scalp, extending to the left, measuring approximately two and one half inches. There was also a bruise located over the nose, measuring approximately one quarter of an inch. There was also a contusion to involve the upper lip that measured approximately one half inch, and there was a tear of the frenulum just inside the mouth. That piece of tissue that attaches the upper part of the lip to the maxilla, the upper ridge that holds the

teeth, and there was a tear that measured approximately one quarter of an inch located just inside the mouth. There was also bruising located over the front surface of the right thigh, measuring approximately one inch, and there was also a bruise located over the front surface of the left thigh that also measured -- or this measured slightly larger, almost an inch and a half at that site. So there were bruises located over the external surface of the body, including the forehead, also the upper lip, the nose, the back of the head, and there was also bruising located to the front surfaces of both the right and the left thighs, sir.

Q. Okay, sir. Did you notice anything or did you observe anything concerning the rectum or rectal area?

A. I would include that in the internal examination. On the internal examination, examination of the lower gastrointestinal tract revealed the presence of a contusion, measuring approximately one inch, and that was located at approximately the nine o'clock area of the rectum extending to approximately the ten o'clock to eleven o'clock area, sir.

Q. You would have done that during your internal examination?

A. Yes, sir.

BY MR. HARPER: May I approach the witness, Your Honor?

BY THE COURT: Yes, sir.

(Mr. Harper hands the witness a glass of water.)

BY MR. HARPER: May I proceed, Your Honor?

BY THE COURT: Yes, sir.

BY MR. SERMOS: Excuse me, Your Honor. One moment. May we move this back just a little bit?

BY THE COURT: Absolutely.

BY MR. SERMOS: We just can't see.

BY MR. HARPER: I am sorry.

(Mr. Sermos moves the easel so the defense table can see.)

BY MR. HARPER:

Q. Dr. Hayne, I am going to hand you what's been marked as State's Exhibit 4 and ask if you'll look at that and tell whether or not that -- I think that photograph may be taken prior to your examination, but is that consistent with what you saw when you made the examination of the child?

A. It shows an injury located over the front surface of the left thigh on the decedent, Chloe Britt. That is the injury that I described measuring approximately two inches located over the front surface of the left lower extremity, sir.

Q. Okay, sir. I see the right lower extremity is in there. Can you -- are you able to observe the injuries that you noted there?

A. There's an injury located over the front surface of the right thigh, and that is slightly smaller, measuring approximately one inch, and it appears to be in view in this photograph, sir.

Q. Okay, sir. You mentioned several. I'm going to show you several photographs. Can you identify this photograph, Doctor? It's State's Exhibit 6.

A. State's 6 is a facial view of the decedent, and it specifically shows injuries that I have described, injuries located over the upper lip as well as over the forehead consisting of bruises located at those sites, sir.

Q. Is that consistent with what you saw on that date of February 22nd when you did your autopsy?

A. Yes, sir. Consistent and also documented.

Q. In fact, you took this photograph or it was taken while at your direction; is that right?

A. That's correct, sir.

Q. I'll hold this one up, Doctor, and ask if you can identify this one.

A. Yes, sir. This shows the facial area of the decedent, and specifically it shows the bruises located to the upper lip, sir. And in the very top of it, you can see the bruises located over the forehead.

Q. Okay, sir. And, again, this photograph was taken by you or at your direction?

A. It was taken by me, sir.

Q. And it fairly and accurately represents what you saw on that particular day?

A. It does, sir.

Q. I hand you what's been marked as State's Exhibit 8 and ask if you'll look at that and tell me whether or not you can identify what's in that photograph, please.

A. I can, sir.

Q. What is that, sir?

A. It shows a tear of the frenulum, a piece of

tissue attaching the upper lip to the upper jaw, sir.

Q. Okay. And, again, does that fairly and accurately represent the injuries that you saw on that child on the date of February 22, 2002?

A. It does, sir.

Q. Again, this was taken by you or at your direction at the autopsy.

A. Taken by me, sir.

Q. Okay. I hand you what's been marked as State's Exhibit 15 and ask if you'll look at that, and tell me whether or not you can identify that photograph. Yes, sir. It is the back of the head of the decedent and upper part of the back of the decedent, sir.

Q. And is there anything significant in that photograph that you can see?

A. There was a bruise located over the back of the head extending towards the left ear, sir.

Q. And, again, this photograph was taken by you and it fairly and accurately represents that injury that you saw?

A. Yes, sir.

Q. Would you point that one out for us.

A. Right there, sir.

BY MR. HARPER: Please the Court, Your Honor. I don't think this photograph -- I don't think it's been published to the jury. May I publish it to the jury.

BY THE COURT: You'll be allowed to do so. That's number --

BY MR. HARPER: Number 15.

BY THE COURT: You will be allowed to publish Exhibit 15 to the jury.

(Mr. Harper passes Exhibit 15 to the jury.)

BY MR. HARPER:

Q. I hand you now what's been marked as State's Exhibit 14 and ask if you'll look at that and tell me whether or not you can identify what's in that photograph?

A. Yes, sir.

Q. And would you tell us what that one --

A. It shows the back of the head of the decedent and upper part of the back and shows a bruise starting in the mid back area going towards the left back of the head, sir.

Q. And I'll will hold that one up and ask if you would point this out for us, please?

A. A bruise located here.

Q. Okay, sir. And that fairly and accurately represents the injury you saw on the child, Chloe Madison Britt, on February 22nd at the time of your autopsy?

A. Yes, sir.

Q. And you took this photograph also?

A. I did, sir.

BY MR. HARPER: Again, Your Honor, I don't think this one has been --

BY THE COURT: You will be allowed to publish that one to the jury also.

(Mr. Harper passes Exhibit 14 to the jury.)

BY MR. HARPER:

Q. Finally I would hand you what's been marked as State's Exhibit 5 and ask if you'll look at that photograph and tell me whether or not you can identify what's in that photograph.

A. Identify what is in --

Q. Yes, sir.

A. What it depicts, sir?

Q. Yes, sir.

A. It depicts the bruise located to the rectum of the decedent, sir. That photograph was taken by me during the course of the post mortem examination.

Q. Okay, sir. I'll ask you, Dr. Hayne. What would that be indicative of, the injuries that you saw to the rectal area, if you can answer that question.

A. It would be consistent with penetration of the rectum with an object, sir.

Q. Okay. Now, I didn't mean to interrupt you, but I thought it might behoove us to go ahead and go through the pictures. So you've testified about your external examination and what you were able to see. What, if anything, did you do after that, Dr. Hayne?

A. An internal examination was conducted. The bruise was identified in the rectal area, and of greater importance, I think, was the presence of significant injury to the head area. When the scalp was reflected, there were bruises located over the scalp. There was also as the calvarium or skull cap was removed. There was also a collection of blood located between the skull and the brain itself, and it -- what's called the subdural space,

collection of a volume of approximately thirty CC's which would be several tablespoons of blood located at that site.

Q. Would that be normal for that -- for that blood to be in the --

A. No. It would indicate injury. It would indicate trauma had occurred.

Q. For in laymen's term if you would for me and whoever else might -- would you tell us -- as I understand it, Dr. Hayne, you actually take the skull, open it, and where you can see inside. Would that be correct?

A. Yes, sir. Initially you make an incision going over the top of my head -- if I may use my finger -- behind each ear. The scalp is moved forward and back exposing the skull cap itself, and located underneath the skin surface of the scalp itself, there were multiple bruises as I indicated. After removal of the skull cap itself, there was a collection of blood between the inner surface of the skull and outer surface of the brain. There are small bridging vessels, small veins that go from the inner surface of the skull to the outer surface of the brain, and when the head is injured, there's transfer of force. The brain usually oscillates back and forth, and it will tear these vessels, and that will allow for the collection of blood in that space, the subdural space, between the inner surface of the skull and the outer surface of the brain. There's also other injury to the brain itself, and that is that surface of the brain had extensive hemorrhage or bleeding over it called a

subarachnoid hemorrhage. So when you actually held the brain in your hand, that blood remained in contact with the brain itself as opposed to the subdural hemorrhage which was left inside the skull itself when the brain was removed. There was also other injury that was identifiable and subsequently confirmed by microscopic examination. That is that the eyes when they were enucleated or removed and sectioned. There was obvious blood in those in the chambers of the eye and the optic nerves that run to the eye from the brain also had hemorrhage that one could readily recognize at the time of the autopsy. The eye is actually part of the brain. It's an extension of the brain. So it's included in the examination of the brain, and there was, I felt, significant -- there was bleeding inside the eyes called retinal hemorrhages as well as bleeding over the surface of the scalp, bleeding between the inner surface of the skull and the brain and also bleeding over the surface of the brain itself.

Q. Would you term it incidental bleeding in these areas that you've described or excessive bleeding? How would you term that?

A. I consider them lethal.

Q. Lethal.

A. Lethal. It would produce death, sir.

Q. Okay, sir. Now, you have some charts, Dr. Hayne. Did you want to show us anything in regard to these -- what you told us in --

A. I think it shows on that one chart the bleeding

over the surface of the brain.

Q. Would you --

BY MR. HARPER: Your Honor, if it please the Court, we'd ask that he be allowed to come down and show them the charts.

BY THE COURT: He'll be allowed to step down if he needs to testify.

(Witness steps down.)

BY MR. HARPER: Let's move it up where the jury can see it better, if I don't drop it.

BY THE COURT: Again, defense counsel and the defendant may move around so that they can see --

BY MR. HARPER:

Q. Dr. Hayne, before we start, let me just ask you. These diagrams are part and parcel of your autopsy report; is that correct?

A. Yes, sir. They're made during the course of the post mortem examination.

Q. Okay, sir. And, if you would, what does this particular chart depict?

A. They're several different views of the brain, looking down on the top of the brain, looking at the bottom of the brain upward, and looking at the left side of the brain, and also looking at the right side of the brain, and on the illustrations, I added notes essentially indicating by the cross checks that there was extensive bleeding in the subarachnoid space on the surface of the brain itself. That there were no contusions or bruises and no tears of the brain itself. Also indicated that

there were no fractures. They were no breaking of the bones composing of the skull, skull cap, base of the skull, and other bones structures. Also indicated that there was a collection of approximately thirty CC's of blood in the subdural space. That space -- may I draw on this?

Q. Yes, sir. Absolutely.

A. If you look at the skull, we've opened it. The brain will sit approximately like that, and there was a space between the inner surface of the skull and outer surface of brain. The subdural space and that is the bleeding that I am referring to down here. There's a collection of blood in this space, and in addition, there was bruising eluded to, involved the scalp in several locations. Some of which were visible on the external examination. Bruises located underneath the scalp --

Q. Let me interrupt you a second. When you got into the internal examination, you found more bruising than what you were able to see from the external --

A. Yes, sir.

Q. -- examination by eye.

A. That's correct, sir. And then on the surface of the brain itself were the areas of bleeding, the subarachnoid hemorrhage, and if one looks at the optic tracts, part of the cranial nerves that go to the eye. There was also bleeding around those structures, and when one examined the eye itself and a cross section of it, the several layers of the retina and they were bleeding in multiple layers of the retina, inside of the eye itself,

and extending to the optic nerve which runs back to the brain.

Q. Okay, sir. All right. Thank you, Doctor. You indicated earlier that what you observed there would be lethal. Were you able to come to a conclusion as to cause of death in this particular case?

A. Yes, sir.

Q. What was that?

A. It was consistent with the shaken baby syndrome, sir.

Q. And would you tell the jury what you mean by that, and if want to have a seat or if you want to use your diagrams.

BY MR. HARPER: If the Court, please, Your Honor. I ask that he be free to get up and come to the charts if he needs to, to show something.

BY THE COURT: He'll have that option if he so desires.

A. It would be consistent with a person violently shaking a small child. Not an incidental movement of a child, but violently shaking the child back and forth to produce the types of injuries that are described as shaken baby syndrome, which is a syndrome known for at least forty-five years now. Coined by a Dr. Coffee who analyzed several of these in Denver, Colorado, and the classic triad for shaken baby syndrome is one, the presence of a subdural hemorrhage; and, two, the presence of retinal hemorrhage; and, three, the absence of other potentially lethal causes of death. Other etiologies or causes of

death. So it's inclusionary and exclusionary. Both inclusionary findings were present. The subdural hemorrhage, the retinal hemorrhage, and also there was an exclusionary competent. I did not find any other cause of death, sir.

Q. You indicated that it would require what you call violent shaking, and I know somewhat demonstrated. How violent are we talking about, Dr. Hayne? I mean, is this something --

A. The type of injuries that you can see that parallel these are in motor vehicle crashes, falls from significant heights and the like, sir.

Q. So we're talking about violent shaking?

A. We're talking about very violent shaking.

Q. Okay. And that was your determination as to cause of death?

A. Yes, sir.

Q. Okay, sir. And did you make a determination as to manner of death?

A. Yes, sir.

Q. And what was that?

A. I thought it was consistent with homicide, sir.

Q. Obviously the child was six months old. Could she do this to herself?

A. No, sir.

Q. Okay. It would have to be someone else that did it?

A. It was another person, sir.

Q. Violently shaken.

A. Violently shaking, producing these injuries and, of course, there were other injuries that were identified on the body, but were not participatory in the death of the child.

Q. And, again, this is what your concentration on is what caused the death. So I would assume that your examination, although thorough, was on the head injuries?

A. Yes, sir. As opposed to a clinical physician who is treating an individual who obviously is alive or has a potential of being resuscitated, and that, of course, focuses different than a person like me who I am looking at the cause and manner of death, sir.

Q. Okay, sir. Now, Dr. Hayne, after you had completed -- or if you would, just go on. You did your internal examination. I believe you talked about some microscopic -- you completed the complete examination as you described to us earlier that you had performed.

A. Yes, sir.

Q. Okay, sir. What, if anything, else did you do or if you would tell us anything of significance that you were able to find during the course of your examination other than what you've already described.

A. The other significant findings were the collection of evidence.

Q. Okay, sir.

A. Photograph documentation, evidence that was submitted to the Mississippi State Crime Lab.

Q. Okay, sir. Would that include the extraction of blood from the victim?

A. Yes, sir. There were several tubes of blood extracted, removed, phlebotomized for different reasons. Toxicology, DNA, serology, and the like, sir.

Q. And those were transported -- transferred to the crime lab --

A. Yes, sir.

Q. -- delivered to them?

A. Under the chain of custody.

Q. Yes, sir.

BY MR. HARPER: The Court will indulge me just one moment, Your Honor.

(Mr. Harper and Mr. Rosenblatt confer.)

BY MR. HARPER:

Q. Dr. Hayne, getting back to your photographs, you talked about the injury to the mouth and the frenulum, I believe you called it?

A. Yes, sir.

Q. What would that be indicative of to you?

A. It could be insertion of an object in the mouth, pulling of the lip, even pushing down on the upper part of the jaw to produce that.

Q. Could be consistent with insertion --

A. It could be.

Q. Penetration?

A. Yes, sir.

BY MR. HARPER: The Court will indulge me one more --

(Mr. Harper and Mr. Rosenblatt confer.)

BY MR. HARPER: Your Honor, I believe that's all

I would have, and we tender Dr. Hayne at this time.

BY THE COURT: Cross-examination.

BY MR. SERMOS: One moment, please, Your Honor.

(Mr. Sermos and Mr. Clark confer.)

CROSS-EXAMINATION

BY MR. SERMOS:

Q. Dr. Hayne, as far as your examination and I don't want to even try to put words in your mouth, but, essentially, the shaken baby syndrome here and the cause of death and then the manner of death, those two things, especially the shaken baby syndrome, that is a totally separate item from any allegations or indications of rectal or sexual abuse; is that correct?

A. The cause of -- yes. The cause of death that I addressed was the shaken baby syndrome. The manner of death, of course, is a product of the cause of death. The other findings were separate, sir. They did not constitute lethal injuries that would produce death in and of themselves, sir.

Q. And then the next question is when you use the word in your report "contusion" -- excuse me one moment, please, and I'll get right to. You had used the word in the rectum there would have been a contusion. In your definition from a medical expert standpoint, is a contusion and a tear the same thing?

A. No, sir.

Q. Okay. Would you please tell the jury what the difference would be?

A. A tear is a laceration most commonly whether

it's a complete, full thickness disruption of the -- in this case, the mucosal surface as opposed to a skin surface. A contusion is a collection of blood underneath the mucosal surface.

Q. Okay.

A. It's a product of tearing of vessels underneath the skin or mucosal surface and bleeding at that site with the subsequent collection of blood.

Q. So that could be caused by something different than would cause a tear; is that correct?

A. Could be, or it could be the same object.

Q. If there were any tears down there in your report when you put a contusion of the anus is noted, I presume you would have also written tears were noticed also; is that correct?

A. If I had seen them, I would put down laceration. I did not see it in this case, and I did not exclude it, but I just didn't see it.

Q. The next part of that is you mentioned in your report on -- actually it's page two after your cover sheet. You put well-formed stool is present within the luminal space of the large bowel.

A. Yes, sir.

Q. Is the large bowel by what you're referring to here, the descending colon?

A. It would include the descending colon, yes.

Q. Okay. So where the next question comes from is this. At the time the baby was deceased, was in the hospital, the other witness have testified that there was

feces coming out of the baby's anus and rectal area, and that it was basically diarrhea type. Now, is there a difference in diarrhea and well-formed stool?

A. Yes, sir.

Q. Okay. My next question would then be what would cause -- if these witnesses testified to this that there was diarrhea, loose bowels, and basically this was at the time of death. When would the well-form stool form? Was it already there?

A. I think the well-formed stool is already present, and that would include the ascending as well as transverse colon. Now, if there was injury to a lower part of the colon that could be a transfer of fluid in that site, and you can get a semi-liquid stool while you have solid stool in the first part of the colon.

Q. Okay. And then that would go to the next part of what you probably would have done -- it's not in your report anywhere, and I don't presume it existed, but had there been some damage into or of the descending colon, you would have noticed that; is that correct?

A. I would have, sir.

Q. And when you stated that around the rectum or the anular ring -- someone has talked about the anus or the anular ring, the sphincter. That there was that contusion there, and that could be caused -- I believe you said by an object?

A. Yes.

Q. If an object had -- when you state that, the object merely has to come into contact with the anus and

it doesn't necessarily imply any massive insertion, does it?

A. No. It implies force.

Q. Right.

A. It implies injury to the mucosal surface subsequently tearing the small vessels underneath the mucosal surface.

Q. Okay. And then, shall we say, and I'll ask you for your expert opinion on this also. If some object were to have been inserted in that child's anus and even gone into the descending colon or the rectal area and that object were found, then that object should have either some form of tissue, matter, blood, or feces on it. Wouldn't you expect that?

A. I would expect to at least see fecal material on it, sir. Maybe other items.

Q. Okay.

BY MR. SERMOS: One moment, please, Your Honor.

BY THE COURT: Certainly.

(Mr. Sermos and Mr. Clark confer.)

BY MR. SERMOS: We have no further questions, Your Honor.

BY THE COURT: All right.

BY MR. HARPER: Just a few questions, Your Honor.

BY THE COURT: Redirect.

REDIRECT EXAMINATION

BY MR. HARPER:

Q. Dr. Hayne, your examination, I believe you said,

was done roughly six o'clock on the 22nd?

A. Yes, sir. It was almost seven o'clock, sir.

Q. Okay, sir. Which my understanding that the child came to the hospital was about 9:40 on the night before. So it was about twenty-two hours or something to that effect by the time you did your examination?

BY MR. SERMOS: Your Honor, we object to this line of questioning. The State had the opportunity to review this with the State's witness on direct.

BY MR. HARPER: Your Honor, they've asked some questions. I think -- I am trying to lay some predicate to ask some questions consistent with --

BY THE COURT: All right. Keep in mind your redirect will be limited to matters brought out on cross-examination.

BY MR. HARPER: I understand, sir.

BY MR. HARPER:

Q. My question to you, Dr. Hayne, with that length of time, would some form of rigor mortis have set in on this child at that point?

A. Yes, sir. The child was in full rigors, very stiff.

Q. How could that affect, if at all, the rectal area as far as how tight it was or loose, or could it affect that?

A. It would contract it, sir.

Q. Okay.

A. But make the luminal diameter, the actual diameter of the rectum smaller, sir.

Q. And if there were a tear in that -- a slight tear or whatever, as it contracted, could be less visible and, in fact, almost appear to be a contusion at that point if it contracts to that extent. Would that be a safe statement?

A. I think the contusions would remain. The small tear, after we washed the body and after rigor has already set up, we may not see that, sir.

Q. And as you stated before, your examination is primarily concerned with the injuries that caused the death; is that right?

A. Yes, sir.

Q. You would have observed other injuries but --

BY MR. SERMOS: Objection, Your Honor. He's going on the things he already asked him when he first started direct.

BY THE COURT: I'll sustain that last question.

BY MR. HARPER:

Q. Would it be safe to say that the doctor examining the child at the hospital would have looked at that injury more closely than you did?

A. They would have looked at it under different circumstances. I think we would look at it very carefully, too.

Q. I understand.

A. But I think there would be alterations in the body that we would see that they would not see.

Q. Or that they might see that you could not see.

A. That's correct, sir.

Q. Thank you, sir.

BY MR. HARPER: That's all I have, Your Honor.

BY THE COURT: You may step down.

BY THE WITNESS: Thank you, Your Honor.

(The witness steps down.)

BY MR. HARPER: Your Honor, we'd ask that Dr. Hayne be released.

BY THE COURT: You'll be released.

BY MR. HARPER: Oh, Your Honor, I am sorry.

BY THE COURT: Okay. Who does the State call as your next witness?

BY MR. HARPER: The Court indulge us just a moment.

(Mr. Harper and Mr. Rosenblatt confer.)

BY MR. HARPER: Your Honor, at this time, the People of the State of Mississippi would rest our case.

BY THE COURT: Okay. Ladies and gentlemen, the State has rested. The case has been moving along quite satisfactorily. It's going to be necessary to take a short recess at this time. So this will be about a fifteen-minute recess. If you will, use the facilities down at the end of the hall. Keep in mind what I said about no contact with anybody involved in this case, and I'm going to need to see counsel and the court reporter in the jury room. So this will be about a fifteen-minute recess.

(The following was heard in the chambers of the Judge, OUTSIDE THE PRESENCE OF THE JURY, to-wit:)

Deposition of Dr. Steven Hayne

IN THE UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF MISSISSIPPI
WESTERN DIVISION

JEFFREY HAVARD — PETITIONER

VS. — CIVIL ACTION NO. 5:08-CV-275-KS

CHRISTOPHER EPPS, et al. — RESPONDENTS

****

DEPOSITION OF DR. STEVEN HAYNE

Taken at the offices of
Watkins & Eager,
400 East Capitol Street,
Jackson, Mississippi,
on Tuesday, November 23, 2010,
beginning at approximately 8:57 a.m.

****

APPEARANCES NOTED HEREIN

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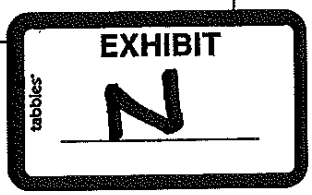

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MR. MAGEE: Good morning. This is the videotaped deposition of Dr. Steven Hayne taken by counsel in the matter of Jeffrey Havard versus Christopher Epps, et al., in the District Court of the Southern District of Mississippi, Western Division. Today's date is November 23rd, 2010. The time is approximately 8:57 a.m. Counsel may now introduce themselves on record.

MR. JICKA: I am Mark Jicka, and I represent Jeffrey Havard.

MR. CARNER: Graham Carner, also for Mr. Havard.

MR. McNAMARA: Pat McNamara representing the Attorney General and Christopher Epps.

MR. MAGEE: The court reporter may now swear in the witness.

(Witness sworn.)

THE WITNESS: I'll waive and may I have a copy?

DR. STEVEN HAYNE,

having been duly sworn, was examined and testified as follows:

EXAMINATION

BY MR. JICKA:

Q. Good morning, Dr. Hayne.

A. Good morning, Counselor.
Q. I'm going to ask you some questions today, and if you don't understand my questions, will you please let me know that?
A. I will do that, sir.
Q. And I will probably butcher some of these terminologies and pronunciations. So if you'll help me, if I say it in the wrong way, you're certainly welcome to correct my pronunciations.
A. Thank you, Counselor.
Q. Will you please provide the Court with your professional qualifications, sir?
A. I'm a pathologist. I work in the fields of anatomic, clinical, and forensic pathology. I've worked in the field for some 35 years. I'm certified in anatomic pathology, clinical pathology, forensic pathology, forensic medicine, forensic physician. I've worked in the state of Mississippi for some 20 years in different capacities in relationship to medical-legal investigation of death, including acting State Medical Examiner, designated State Pathologist, and Chief State Pathologist.
Q. And tell me a little bit about your education, sir.
A. I did the predominant of my undergraduate

work at North Dakota State, spent two years at the University of North Dakota School of Medicine, and transferred to Brown University in Providence, Rhode Island, where I completed my medical degree, and then I went to San Francisco at Letterman Army Medical Center, where I trained in pathology. I rotated at numerous institutions in the San Francisco Bay area, including Children's Hospital, University of California Moffitt Hospital, Union Memorial Blood Bank, the Medical Examiner's Office for the City and County of San Francisco, as well as others, and then the last six months, I spent in nuclear medicine.

Q. Can you list for the Court your qualifications in the area of child sexual abuse investigation and diagnosis?

A. It's part of the field of forensic pathology. I've also authored in the field. I wrote a paper with Dr. Hammer, also a resident at the time, at -- stationed at the Presidio with Letterman Army Medical Center, in conjunction with my chief, Colonel Starkey, and the Chief of OBGYN, Colonel Ansbacher. We published that. It was a requirement for graduation of a residency program that you submit and have accepted a paper for publication. So Dr. Hammer and I were pretty good friends, so we co-authored that

paper, and published it. And it was basically identification, collection of evidence, treatment, and the like. It was a comprehensive paper, and it had a long checklist, so it could be posted in an emergency room somewhere, you can go right down the list. And also, when I was in the military, not by choice, but I had to do a lot of sexual assault work-ups in the United States Disciplinary Barracks at Fort Leavenworth, which, as you know, homosexuality in a military institution like that is a major offense under the Uniform Code of Military Justice. So I had to go in night after night and do that work. And many times we have had cases of sexual assault involving death of a human being that we've done medical-legal postmortem examinations on.

Q. Have you been accepted as an expert in this field in courts?

A. Yes, sir.

MR. JICKA: Pat, I know the procedure here is a little different than a typical case, and I don't know if you would have any objection, but -- and I don't know if you have any questions, but we would tender him as an expert witness.

MR. McNAMARA: He's already been accepted as an expert in this case.

MR. JICKA: Okay. And I would agree with you on that.

BY MR. JICKA:

Q. Dr. Hayne, you performed an autopsy on Chloe Britt; is that correct?

A. Yes, Counselor. You pronounce it Chole Britt.

Q. I think it's Chloe.

A. Chloe?

Q. But I'm not sure.

A. Because it is an Hispanic name. It would be Chole (sic) if it was in Spanish. Maybe it would be Chole.

Q. Why don't we call her Miss Britt? And that was part of your duties in your profession; is that correct?

A. That's correct. Now, on that date of 2002, actually, it was the 22nd of February when the postmortem examination was conducted.

Q. And do you have a copy, Dr. Hayne, of your final report of autopsy with you today, sir?

A. I do, Counselor.

MR. JICKA: Okay. And, Pat, I'm going to mark that final report of autopsy as an exhibit to his deposition.

(Exhibit 1 marked.)
BY MR. JICKA:
Q. Dr. Hayne, what was the purpose for you doing an autopsy on Miss Britt?
A. It was to come to conclusions as to cause and manner of death, cause of death being the medical reason Miss Britt died, and the manner of death is the classification of the death. And one has to come to a conclusion, if it's suicide, accident, homicide, natural, pending, or undetermined. Of course, sometimes, cause of death, one cannot come to a conclusion.
Q. Okay. And were you asked to do that by the coroner of Adams County, sir?
A. The county coroner, medical examiner, investigator is his official title, and it was James Lee.
Q. And as part of his request for you to do an autopsy on Miss Britt, was there documentation or a permit that was issued to you by the Adams County Coroner?
A. Yes, Counselor, there's a State form called a ME-1, Medical Examiner 1 form, and that I made part of the postmortem examination as a routine practice of business.

MR. JICKA: And I'm going to mark that, Pat, as Exhibit 2, the permit from the Coroner of Adams County.

(Exhibit 2 marked.)

BY MR. JICKA:

Q. What is the purpose when you receive this permit, as you use it in your work?

A. Well, it's the request from the County in writing to perform a medical-legal or forensic autopsy the remains so identified on the paperwork, the ME-1 -- or ME-17 form.

Q. And on the permit that involves Miss Britt, it lists different circumstances, I believe, for you to, I guess, determine or to look at as you're conducting your autopsy; is that correct?

A. That's correct.

Q. And one of those I see there is a note about sexual assault. Do you see that located?

A. I do.

Q. And as part of your autopsy, even from the beginning of the autopsy, was it part of your work to determine whether there could be shown that there was a sexual assault in this case?

A. In fact, to come to a conclusion, that -- or not come to a conclusion, final conclusion.

Q. All right. But even from the beginning of your work in this case, you knew that sexual assault was at least an issue, at least in the minds of the coroner and the district attorney, as presented to you?

A. Not only from the paperwork, Counselor, but also from telephonic communication from the County Coroner, Medical Examiner, Investigator.

Q. You did conduct an autopsy on Miss Britt; is that correct?

A. I did, Counselor.

Q. And in the report, there's no mention of a sexual battery on this child; is that correct?

A. That is correct.

Q. And why is that not listed as something in your final report of autopsy?

A. I could not come to a final conclusion as to that, Counselor.

Q. Okay.

A. There was one injury that I indicated would be consistent with the penetration of the anal area, but that, in and of itself, I didn't feel was enough to come to a conclusion that there was a sexual assault in this particular death.

Q. Okay. When you did your autopsy, you were

not able to find any tearing of the anal area on this child; is that right?

A. No, there was not.

Q. If that is something that you had noted or found, then would you have noted it in your report, correct?

A. I would have.

Q. And you also would have had photographs that would have shown that on this child, correct?

A. I would have.

Q. All right. And it's mentioned -- sexual assault or battery is not mentioned anywhere in this report; is that correct?

A. No, I did not see evidence of that, Counselor. I was asked in court, but I did not see evidence in the autopsy, and, therefore, did not reflect it in the report.

Q. You did find a one-centimeter contusion; is that correct?

A. That's correct.

Q. Just for the record, how big is a one-centimeter contusion?

A. Approximately like that, Counselor.

Q. Okay. Now, but that was not listed in the list on the autopsy report as a traumatic injury; is

that correct?

A. It wasn't, but it was listed in the body of the report, and also in the illustration body diagram.

Q. In other words, you noted it in your report, but did not list it as a traumatic injury to this child?

A. That's correct.

Q. And is that because there could be many possible alternative causes for a contusion such as this found on this child?

A. It's probably a typo error, Counselor, because I'm sure I dictated it, but the typist skipped it.

Q. All right. The photographs we mentioned didn't show any tearing; is that correct?

A. That is correct.

Q. All right. And, further, no tearing was listed or noted in the autopsy report?

A. No lacerations or abrasions were identified, only a single contusion.

Q. In this case, Dr. Hayne, you had prepared earlier a declaration. Have you had an opportunity to look at that?

A. I have.

MR. JICKA: I'm going to mark this, Pat, as

the next numbered exhibit to Dr. Hayne's deposition, which will be Exhibit 3.

(Exhibit 3 marked.)

BY MR. JICKA:

Q. Dr. Hayne, were you able to review this declaration and correct it for any errors prior to executing it on March 5th, 2009?

A. Well, sir, I'm looking to see if I can find in my file here what you're addressing.

Q. I've got an extra copy.

A. Thank you.

Q. In this declaration, Dr. Hayne, it, first of all, involves your work and your opinions in the Jeffrey Havard matter, correct?

A. That's true.

Q. And you state, again, and forgive me, Pat, I'm going to try not to be too redundant on this in this deposition today, but, in there, you state that you found no tears -- this is in paragraph seven, Dr. Hayne.

A. Yes, sir.

Q. No tears to the rectum, anus, anal sphincter or perineum; is that correct?

A. That's correct.

Q. And it's not possible that tears would have

healed between the time that Miss Britt was seen in the emergency room and that you performed the autopsy?

A. They would not.

Q. I want to ask a little bit about this area of the human body. Do you agree that there's a delicate tissue lining of the anus rectum that can be damaged easily in a child of this age?

A. It can. It is a squamous mucosa lining, not skin.

Q. Okay.

A. And that is more easily injured, traumatized, than skin surface.

Q. And an injury can occur in a child like this, even by the application of a rectal thermometer; is that correct?

A. That could happen, but, Counselor, I think that would be highly unlikely to see an injury of such size as secondary to the placement of a thermometer by medical personnel.

Q. Okay. All right. And in reviewing the medical records, did you see where her temperature was taken by rectal thermometer on multiple occasions while she was in the emergency room?

A. I did see that, sir.

Q. As part of the final autopsy report, there's

also a mention of a sexual assault kit.

A. An RSVK 1111 kit was employed to collect evidence that was subsequently submitted to the Mississippi Crime Lab under chain of custody.

Q. And as part of your work here, and as a result of the sexual assault kit, isn't it true that there was no semen found after a serological evaluation conducted on this child?

A. Actually, by microscopic examination, but no spermatozoa were identified.

Q. Okay. And swabs -- I guess what happens is that you will take swabs from different areas of the child's anatomy; is that correct?

A. That's correct.

Q. And then you will look under a microscope for any evidence that there might be sperm; is that correct?

A. That's correct. We look both oral, anal, and vaginal.

Q. And on this, it looks like, from the oral swab, the vaginal, and the rectal swab, that there was no evidence found of spermatozoa; is that correct?

A. That's correct. There are additional tests that can be performed, serological tests, and I believe those were performed, too, and they were also

negative.

Q. Okay. And the serological evaluation was done with -- from an oral standpoint, a vulvar standpoint, a vaginal standpoint, and a rectal standpoint; is that --

A. I believe that is correct, sir.

Q. Dr. Hayne, what are the signs of brain death or lack of brain function in a child like this?

A. If you have brain death, first, there would be flaccidness. There would be unconsciousness. There would be muscle relaxation. There would be lack of breathing, unless there was artificial respiration being delivered. Body functions would essentially cease, either at that time or shortly thereafter. Eventually, there would be breakdown in tissue, lytolisis, purification, and the like.

Q. Okay. Reviewing the medical records for Miss Britt, I noted certain things, and I want to just mention and ask if these are signs or could be signs of lack of brain function, some of which you've already mentioned. Dilated pupils, sir?

A. That would be.

Q. Fixed pupils?

A. That would be.

Q. Lack of muscle tone?

A. That would be, also.
Q. Asystole?
A. Asystole?
Q. Asystole, thank you.
A. Yes. That would be if the heart is no longer functioning. You can have brain death and still have functioning of the heart. Cardiovascular functionality could remain for a period of time, and respiratory could for a period of time, too.
MR. McNAMARA: I would have to interject and object at this time based on this is outside the scope of what we're here for as far as the sexual assault goes, without it being tied together as it is, and I would object to the continuing leading of the witness.
MR. JICKA: Okay. And I'll -- I will try not to lead. Dr. Hayne has a kind of interesting position in this case, so I'm not sure exactly what witness he would be considered by the Court, but I'll -- I don't mind asking nonleading questions.
A. May I interject one part to my -- one last part to my answer?
BY MR. JICKA:
Q. Sure.
A. There are many definitions of death. It could be cardiovascular, respiratory, central nervous

system, somatic, cellular, and they all vary, you know, as to response of an individual.

Q. Based upon -- you've reviewed the medical records for Miss Britt in this case; is that correct?

A. I have, Counselor.

MR. JICKA: I'm going to mark those as Exhibit 4 to your deposition.

(Exhibit 4 marked.)

BY MR. JICKA:

Q. Based upon the information available to you, Dr. Hayne, was Chloe Britt brain dead or lacked brain function at the time that her anal dilation was first noted?

A. It was.

Q. And this was after she was successfully intubated; is that correct?

A. That's correct.

Q. And is this an opinion within a reasonable degree of medical certainty, sir?

A. As reflected in the medical record, yes.

Q. Okay. Do you commonly encounter dilated anal sphincters during a postmortem examination?

A. It can occur, but it's not as common as I think people think.

Q. Is that a recognized finding in the

postmortem period?
A. It can be, yes.
Q. And do children who have died of brain injuries have an increased likelihood of having a dilated anus postmortem?
A. It's possible. I think you supplied me with one article from the Orange Journal, '97, "American Journal of Forensic Medicine and Pathology." In that particular article, there were 65 cases of which only a handful were involving children of less than one year of age, and of those --
MR. McNAMARA: I object again. This is not relevant to what we're speaking about. This is a general study. This is not the case that we're talking about.
BY MR. JICKA:
Q. Go ahead, sir.
A. And of all those, only one had suffered a traumatic death. In that particular case, the anus was described as slit-like. So in that case, there was no dilatation in a violent death that Dr. Lauridson is referring to in his opinion of 65 cases published in the Orange Journal.
MR. JICKA: And, Pat, I don't -- certainly I'm not dismissing your objection, but this goes

directly to what we believe to be an issue in this case and allowed by Judge Starrett in his order.

BY MR. JICKA:

Q. Can resuscitation efforts result in a large amount of gas accumulating in the gastrointestinal tract?

A. Ineffective resuscitation, cardiopulmonary resuscitation. I do not believe that was the case in this particular individual, in that there was stool in the large bowel, and that would have effectively blocked the passage of air going down the gastrointestinal tract and dilating the distal part of the GI tract.

Q. So can this gas, the air and the amount of pressure on the bowel and colon, facilitate the passage of stool?

A. It's possible, yes, ineffective cardiopulmonary resuscitation.

Q. And isn't that what they had at the emergency room here, they had an ineffective CPR with this child?

A. It would only be my impression. They are medically-trained personnel to deliver cardiopulmonary resuscitation in an adequate manner.

Q. But this child was not revived at any point

in time that you reviewed in the medical records?
A. No, sir, was not.
Q. Okay. If the gas enters into the colon, could that cause distention of the colon, and the rectum, and promote further dilation of the anus?
A. If that had occurred, yes sir. I saw no evidence of that occurring, but if -- in a general sense, if gas is pushing stool, it can dilate, pack the stool, enlarging the distal bowel, yes, it could do that.
Q. Okay. And could a spontaneous bowel movement also contribute to anal dilation?
A. Only if they're very hard stool would I expect to see that, if there's enough pressure with force with the chest or enema, you can -- even in cases of acute appendicitis, in patients that have survived. So that can occur, but that's pushing stool down into the space of the vermiform appendix, but I didn't see evidence of that in this particular case.
Q. If Chloe Britt was oxygen deprived for 45 minutes to an hour before the anal dilation, is it possible that she was -- was located, is it probable that she lacked brain function?
A. Forty-five minutes?
Q. Forty-five minutes to an hour?

A. That would be reasonable that she would have been dead.

Q. Okay.

A. You can survive for a few minutes with oxygen deprivation, if it's total oxygen deprivation. The brain has a store of glucose and oxygen for approximately 15 to 30 seconds, then unconsciousness will commence, and shortly after that, within two to three minutes, death will intervene.

Q. In your autopsy report, Dr. Hayne, you note, several times, congestion. If you'll look -- you see on your finding, sir?

A. Yes, sir.

Q. Can congestion cause contusions?

A. No.

Q. Okay. The congestion that you found with Chloe Britt, where was it located?

A. It was in the viscera, the major organs. That's not to be unexpected. I don't think this death was an immediate death, and there would be a period of time, an agonal phase of death where the cardiovascular activity would be diminishing, pumping efficiency would also diminish, and blood would have a tendency to pool in the different organs, the lungs, spleen, kidneys, and the like, the liver.

Q. The inner mucosa of rectum, is it sometimes visible after death in an autopsy?

A. It could be. It's unusual. You would have to spread the buttocks to look and see that.

Q. And what would it look like? Would it have a pink or red coloring to it?

A. Usually be a pinkish color, where there would be congestion, usually dependent from the geographic or the gravitational pull of blood downward.

Q. And if that inner mucosal lining was observed even by physicians, could it be confused as an anal injury?

A. I would think not, Counselor. I can't speak for them, but a contusion is usually fairly-well circumcised and outlined, while congestion would not be, but I would hate to speak for them.

Q. Okay. Flaccid, that's the same as limp; is that correct?

A. That's correct.

Q. Could a flaccid or limp muscle condition contribute to anal dilation?

A. That could, yes.

Q. Okay. And a dilated anal sphincter is not, on its own, evidence of anal sexual abuse; is that correct?

A. It is not by itself, no.
Q. Okay. To determine that sexual abuse is a probability, you would need additional evidence than just the dilated anus; is this correct?
A. I would like to see more evidence as to traumatic injuries, also clinical history, and, hopefully, by laboratory testing.
Q. Okay. And we don't have here in your analysis, and your autopsy of Miss Britt, that additional type of evidence; is that correct?
A. Do not. I only have a contusion, which is a traumatic injury. We do not have abrasions, lacerations, presence of seminal fluid, spermatozoa, and the like.
Q. And, Dr. Hayne, can you say from your autopsy evidence, and from the coroner's inquest, the medical records that you reviewed, the photographs, and the laboratory findings, that this child, Miss Britt, was sexually assaulted?
A. I could not come to that final conclusion, Counselor. As I remember in trial testimony, I said that the contusion would be consistent with a sexual abuse, but I couldn't say that there was sexual abuse, and, basically, I deferred to the clinical examination conducted at the hospital.

Q. And so from your standpoint and from your expertise, you cannot say that this child was sexually abused, to a reasonable degree of medical certainty; is that correct?

A. I could not now and I could not then, either; at the trial, or when I wrote the report, or discussed the case with the coroner.

Q. Okay. Is physical sexual abuse of a child a medical diagnosis?

A. Well, there's a component of a medical diagnosis. You're describing also a legal issue, too.

Q. Right.

A. The diagnosis could come from laboratory testing. It could come from physical exam by a treating physician. It could also come from a pathologist in a case where there's death, also from scene investigation. So it's a combination of things, but it's also a legal, and as you notice, I never used the term, "rape." That is a legal term, not a medical term.

Q. Yes, sir. Are you familiar with the expertise of the doctors and nurses that treated this child at the emergency room?

A. I'm not.

Q. Do you know --

MR. McNAMARA: Object to anything along this line. The doctor has stated he is not familiar with their qualifications. He'd be completely incompetent to answer any questions regarding that.

BY MR. JICKA:

Q. Do you know what, if any, experience they had ever treating children that had had sexual abuse?

A. I don't know that, Counselor.

Q. Would you agree that it takes a certain medical expertise to determine whether a child has ever been sexually abused?

A. I would agree with that, yes.

Q. And in this case, from your work, hired by the State, you could not make a determination that sexual abuse was a probability in this case, correct?

A. I could not come to a final conclusion, Counselor. I could only come to the conclusion I so testified in court, that the contusion was consistent with what I've seen in a sexual abuse case. And also, just technically, I was contracted not with the State, but by the County.

Q. Thank you.

A. Adams County.

Q. And I appreciate it. Thank you for correcting that. Dr. Hayne, you testified at Jeffrey

Havard's trial, correct?

A. I did, sir.

Q. And you were not asked, actually, about sexual battery during that trial, were you, sir?

A. Not specifically, no.

Q. But you were aware, from even from the coroner's permit, that that was an issue in the case, correct?

A. Oh, yes, and I knew before I even stepped on the witness stand that was going to be an issue.

Q. Okay. And prior to the trial, you discussed this with the district attorney whether you could say to a reasonable degree of medical certainty or even to a probability that sexual abuse occurred, correct?

A. That's correct. But all I could tell the district attorney, prior to trial, was that there was a contusion, and that would be consistent with sexual abuse, but I'd like to see more evidence before I made that next and more significant evaluation and conclusion.

Q. Okay. You -- if you had been asked the same questions we -- that I've been asking you today in court about sexual abuse, would you have answered them in the same manner, sir?

A. Exact way. I think I at least touched on

some of those, and I have not changed my opinion, and it would make no difference whether defense or prosecution was asking me, the answer would be the same.

Q. That leads me to my next question. Did you ever meet with Gus Sermos or Robert Clark, Mr. Havard's attorneys about this case?

A. I don't remember that, Counselor, but I --

MR. McNAMARA: And I object. This is off the subject, not relevant.

BY MR. JICKA:

Q. If requested by them, would you have met with the attorneys for Mr. Havard in this case?

A. I always honor those requests, either prosecution or defense.

Q. And would you have answered their questions in a meeting the same way you have today, if asked?

A. If they were asking the same questions, I would respond the same way.

Q. Dr. Hayne, you can't say, or can you say, that Chloe Britt was sexually penetrated to a reasonable degree of medical certainty in this case?

A. I cannot. All I can say is the injury sustained would be consistent with that, but that's not a definitive diagnosis. And maybe I should

explain.

Q. Sure.

A. I use a series of qualifiers, with reasonable medical certainty, I can say exclude, suggestive of, may fit, consistent with, and diagnostic of.

Q. Okay. Let's go off the record for a second. Let me review my notes and see what else I have.

A. Sure.

MR. MAGEE: Off the record. The time is 9:30.

(Recess.)

(Exhibit 5 marked.)

MR. MAGEE: Back on the record. The time is 9:40.

BY MR. JICKA:

Q. Dr. Hayne, thank you for helping me through this information today. What I'd like to do is show you what I've marked as Exhibit 5, and ask you if you can identify what that document is, sir?

A. This is a report from the Mississippi Crime Lab, their facility in Jackson, concerning samples that were collected. This would be -- appears to be from the hospital, including clothing, and then there's also a pillow case, and there's a purple-top tube of blood, and then it discusses the results of

the studies that --

MR. McNAMARA: I'll have to object. It sounds like the doctor is not familiar with this document.

MR. JICKA: All right.

BY MR. JICKA:

Q. Go ahead, sir.

A. And then remarks that some of the specimens were retained for DNA testing, also on an Eddie Walker. From an Eddie Walker, I should say.

Q. And, basically, in Exhibit 5, we have some results from a sexual assault evidence collection kit labeled Jeffrey Havard; is that correct?

A. Yes, sir.

Q. And in your work, are you familiar what makes up these sexual assault evidence collection kits?

A. I am, sir. We use them routinely.

Q. And what is that, sir?

A. RSVK 1111 kit, that would be for collection of saliva, collection of vaginal in fluid, rectal swabs, vaginal swabs, vulvar swabs, oral swabs, any clothing, hair samples, and the like, also, DNA tube of blood.

Q. And in all of the evidence that you had mentioned and that's shown here on Exhibit 5, was

there any evidence or DNA connecting Jeffrey Havard with a sexual abuse of Miss -- of the child, Miss Britt?

A. In this particular one, I do not see evidence of that. This is basically clothing and other items involving the defendant and the decedent. This is not the material, that I can determine, that was submitted from the autopsy itself.

Q. So this would be additional materials that were tested with -- under the sexual assault evidence kit, in addition to the swabs that you've already testified about; is that correct?

A. That's correct. It indicates such items as clothes removed at Natchez Community Hospital.

MR. McNAMARA: And for the record, I continue to object. This is not a document that the doctor is familiar with or was generated by the doctor.

A. And fitted sheet beside a stove, and a used baby diaper, and items like that, Counselor.

BY MR. JICKA:

Q. Thank you, sir. All right. That's going to be Exhibit 5. Dr. Hayne, I usually start with this, but I guess I'll end at least your direct examination with this. We had noticed your deposition and asked you to bring anything that you had with you regarding

this matter. What do you have in your possession involving this Jeffrey Havard matter, sir?

A. This is the complete file, and I also brought a tape. This the complete file that I have, Counselor.

MR. JICKA: Okay. Thank you, sir. All right. I'm going to make Exhibit 6 his notice of the videotaped deposition. All right. We will tender the witness, Pat.

(Exhibit 6 marked.)

EXAMINATION

BY MR. McNAMARA:

Q. Doctor, let's start off real quickly and just ask you, is your -- in your opinion, the testimony that you've given today, is it consistent with the testimony that you gave at trial?

A. It is, sir.

Q. Have you had any change of heart? Would you change your testimony?

A. I've seen no new facts to change my testimony, Counselor.

Q. Okay. I'll ask -- I have here -- have you seen the pictures you took at the autopsy --

A. Not since the trial, sir.

Q. -- in review? Okay. I'll pass you these

three -- what I have here is a copy of the three, and we'll ask that that be substituted as an exhibit. And can you identify those pictures or do you recall those? They have your markings on there.

A. Yes, Counselor, I do recognize these.

(Exhibit 7 marked.)

BY MR. McNAMARA:

Q. Okay. One question I'd ask, as you see those injuries to the child's anus there, do you find that to be consistent with the insertion of a child's rectal thermometer?

A. I did not think that was an insertion injury from a rectal thermometer by medical personnel. I could not exclude it, but I think it was unlikely, Counselor.

Q. Okay. That is an abnormal anus, isn't it?

A. It is, Counselor.

Q. Did you -- to the question of the lack of semen or DNA evidence, is there a requirement that someone else's DNA or semen be present?

A. No, sir.

Q. They're just cause for penetration, is that correct?

A. That's correct, sir. It does not necessarily mean that a penis was the device used to penetrate.

It could be some other object.
Q. There are several references throughout the trial, something about 12 o'clock, there was an injury at 12 o'clock of the anal area?
A. Yes, Counselor.
Q. Where exactly is 12 o'clock on that?
A. May I point, Counselor?
Q. That would be at the top, where --
A. Yes, Counselor.
Q. -- there's sort of a slender -- it's round in one area, and then it goes up and it's sort of slender?
A. That's correct, sir.
Q. Is that normal for a child to have that -- that wouldn't be a tear, that would just be -- what would that be?
A. For what?
Q. I'm sorry. The -- at 12 o'clock, it shows -- the pictures you're holding, there is a picture of the baby's anus?
A. That's correct.
Q. And it's rounded; is that correct?
A. It's elliptical.
Q. Well, toward the top of that 12 o'clock area, does it -- it peaks, it goes up, and comes to a point;

is that -- that's how I'm looking at it.
A. Yeah, it points towards the perineum, yes.
Q. Is that indicative of that's not a tear, that would be just a stretch?
A. I did not see a tear, Counselor, no.
Q. What is that indicative of, that 12 o'clock injury?
A. There was dilatation at that site, Counselor.
Q. Okay. But it was dilatation of the entire anus, correct?
A. Yes, but more pronounced at that point.
Q. Okay. In describing that in your report, you say, on page 6 of your report, section F, gastrointestinal system, do you see that one? I'm sorry, I may be --
A. Yes.
Q. You've got it?
A. Yes.
Q. Is it says, "A section of anus reveals submucosal hemorrhage."
A. Yes.
Q. Where did you explain submucosal hemorrhage?
A. That is in the microscopic, "A section of anus reveals submucosal hemorrhage," yes, Counselor. That would be the contusion.

Q. And a contusion is?
A. Located at the point that I indicated to you.
Q. Okay. The definition of a contusion, what would that be?
A. Contusion is a tearing of blood vessels underneath the skin or mucosa with collection of blood at that site manifested by an area of discoloration, when one's looking at the injury, external to the injury itself. The lining, either the skin or mucosa, remains intact, and usually there's no bleeding on the skin or mucosal surface.
Q. Okay.
A. If one takes a microscopic section, you can see bleeding outside the vessels into the soft tissue, which would separate congestion from a traumatic injury, is a contusion.
Q. Okay. Final question, so -- being redundant, but you're saying, your testimony today is it's still consistent with what you testified to at trial, and you wouldn't change it?
A. No, sir. I would only change it if I saw additional information. And I'd like to point out, I did not come to a final conclusion.
Q. Okay. But you would agree with your testimony then that the injuries were consistent with

an object being inserted or penetration?

MR. JICKA: Object to the form.

A. Yes, they were consistent with that.

MR. McNAMARA: That's all I have.

MR. JICKA: Just one second. Let's go off the record.

MR. MAGEE: Off the record. The time is 9:53.

(Recess.)

MR. MAGEE: This concludes the deposition. The time is 9:56.

(Whereupon the deposition was concluded at 9:56 a.m., the same day.)

CERTIFICATE OF COURT REPORTER

I, Catherine M. White, C.S.R. and Notary Public, Hinds County, Mississippi, do hereby certify:

That on the 23rd day of November, 2010, there appeared before me, pursuant to notice and the Federal Rules of Civil Procedure, Dr. Steven Hayne as a witness in the above-mentioned cause;

That said witness was duly sworn by me to tell the whole truth, and nothing but the truth in said cause;

That counsel appeared on behalf of the respective parties as hereinbefore set forth;

That the foregoing deposition was taken by me by means of Stenograph machine and translated into transcript form by me, and that the foregoing 38 pages contain a full, true and correct transcription of the testimony of said witness;

That I am not in any way associated with any of the parties to said cause of action, or their counsel, and that I am not interested in the event hereof.

IN WITNESS WHEREOF, I have hereunto set my hand this the 29th day of November, 2010.

STATE OF MISSISSIPPI ★ CATHERINE M. WHITE ★ NOTARY PUBLIC ID No. 16448 Commission Expires February 1, 2014 HINDS COUNTY

Catherine M. White

Catherine M. White
CSR No. 1309
My Commission expires: 2/1/2014

Deposition of Dr. Steven Hayne

IN THE UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF MISSISSIPPI
WESTERN DIVISION

JEFFREY HAVARD — PETITIONER
VS. — CIVIL ACTION NO. 5:08-CV-275-KS
CHRISTOPHER EPPS, et al. — RESPONDENTS

****

DEPOSITION OF DR. STEVEN HAYNE

Taken at the offices of
Watkins & Eager,
400 East Capitol Street,
Jackson, Mississippi,
on Tuesday, November 23, 2010,
beginning at approximately 8:57 a.m.
****

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EXHIBIT INDEX

MR. MAGEE: Good morning. This is the videotaped deposition of Dr. Steven Hayne taken by counsel in the matter of Jeffrey Havard versus Christopher Epps, et al., in the District Court of the Southern District of Mississippi, Western Division. Today's date is November 23rd, 2010. The time is approximately 8:57 a.m. Counsel may now introduce themselves on record.

MR. JICKA: I am Mark Jicka, and I represent Jeffrey Havard.

MR. CARNER: Graham Carner, also for Mr. Havard.

MR. McNAMARA: Pat McNamara representing the Attorney General and Christopher Epps.

MR. MAGEE: The court reporter may now swear in the witness.

(Witness sworn.)

THE WITNESS: I'll waive and may I have a copy?

DR. STEVEN HAYNE,
having been duly sworn, was examined and testified as follows:

EXAMINATION

BY MR. JICKA:

Q. Good morning, Dr. Hayne.

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A. Good morning, Counselor.
Q. I'm going to ask you some questions today, and if you don't understand my questions, will you please let me know that?
A. I will do that, sir.
Q. And I will probably butcher some of these terminologies and pronunciations. So if you'll help me, if I say it in the wrong way, you're certainly welcome to correct my pronunciations.
A. Thank you, Counselor.
Q. Will you please provide the Court with your professional qualifications, sir?
A. I'm a pathologist. I work in the fields of anatomic, clinical, and forensic pathology. I've worked in the field for some 35 years. I'm certified in anatomic pathology, clinical pathology, forensic pathology, forensic medicine, forensic physician. I've worked in the state of Mississippi for some 20 years in different capacities in relationship to medical-legal investigation of death, including acting State Medical Examiner, designated State Pathologist, and Chief State Pathologist.
Q. And tell me a little bit about your education, sir.
A. I did the predominant of my undergraduate

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work at North Dakota State, spent two years at the University of North Dakota School of Medicine, and transferred to Brown University in Providence, Rhode Island, where I completed my medical degree, and then I went to San Francisco at Letterman Army Medical Center, where I trained in pathology. I rotated at numerous institutions in the San Francisco Bay area, including Children's Hospital, University of California Moffitt Hospital, Union Memorial Blood Bank, the Medical Examiner's Office for the City and County of San Francisco, as well as others, and then the last six months, I spent in nuclear medicine.
Q. Can you list for the Court your qualifications in the area of child sexual abuse investigation and diagnosis?
A. It's part of the field of forensic pathology. I've also authored in the field. I wrote a paper with Dr. Hammer, also a resident at the time, at -- stationed at the Presidio with Letterman Army Medical Center, in conjunction with my chief, Colonel Starkey, and the Chief of OBGYN, Colonel Ansbacher. We published that. It was a requirement for graduation of a residency program that you submit and have accepted a paper for publication. So Dr. Hammer and I were pretty good friends, so we co-authored a

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paper, and published it. And it was basically identification, collection of evidence, treatment, and the like. It was a comprehensive paper, and it had a long checklist, so it could be posted in an emergency room somewhere, you can go right down the list. And also, when I was in the military, not by choice, but I had to do a lot of sexual assault work-ups in the United States Disciplinary Barracks at Fort Leavenworth, which, as you know, homosexuality in a military institution like that is a major offense under the Uniform Code of Military Justice. So I had to go in night after night and do that work. And many times we have had cases of sexual assault involving death of a human being that we've done medical-legal postmortem examinations on.
Q. Have you been accepted as an expert in this field in courts?
A. Yes, sir.
MR. JICKA: Pat, I know the procedure here is a little different than a typical case, and I don't know if you would have any objection, but -- and I don't know if you have any questions, but we would tender him as an expert witness.
MR. McNAMARA: He's already been accepted as an expert in this case.

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MR. JICKA: Okay. And I would agree with you on that.
BY MR. JICKA:
Q. Dr. Hayne, you performed an autopsy on Chloe Britt; is that correct?
A. Yes, Counselor. You pronounce it Chole Britt.
Q. I think it's Chloe.
A. Chloe?
Q. But I'm not sure.
A. Because it is an Hispanic name. It would be Chole (sic) if it was in Spanish. Maybe it would be Chole.
Q. Why don't we call her Miss Britt? And that was part of your duties in your profession; is that correct?
A. That's correct. Now, on that date of 2002, actually, it was the 22nd of February when the postmortem examination was conducted.
Q. And do you have a copy, Dr. Hayne, of your final report of autopsy with you today, sir?
A. I do, Counselor.
MR. JICKA: Okay. And, Pat, I'm going to mark that final report of autopsy as an exhibit to his deposition.

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(Exhibit 1 marked.)
BY MR. JICKA:
Q. Dr. Hayne, what was the purpose for you doing an autopsy on Miss Britt?
A. It was to come to conclusions as to cause and manner of death, cause of death being the medical reason Miss Britt died, and the manner of death is the classification of the death. And one has to come to a conclusion, if it's suicide, accident, homicide, natural, pending, or undetermined. Of course, sometimes, cause of death, one cannot come to a conclusion.
Q. Okay. And were you asked to do that by the coroner of Adams County, sir?
A. The county coroner, medical examiner, investigator is his official title, and it was James Lee.
Q. And as part of his request for you to do an autopsy on Miss Britt, was there documentation or a permit that was issued to you by the Adams County Coroner?
A. Yes, Counselor, there's a State form called a ME-1, Medical Examiner 1 form, and that I made part of the postmortem examination as a routine practice of business.

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MR. JICKA: And I'm going to mark that, Pat, as Exhibit 2, the permit from the Coroner of Adams County.
(Exhibit 2 marked.)
BY MR. JICKA:
Q. What is the purpose when you receive this permit, as you use it in your work?
A. Well, it's the request from the County in writing to perform a medical-legal or forensic autopsy the remains so identified on the paperwork, the ME-1 -- or ME-17 form.
Q. And on the permit that involves Miss Britt, it lists different circumstances, I believe, for you to, I guess, determine or to look at as you're conducting your autopsy; is that correct?
A. That's correct.
Q. And one of those I see there is a note about sexual assault. Do you see that located?
A. I do.
Q. And as part of your autopsy, even from the beginning of the autopsy, was it part of your work to determine whether there could be shown that there was a sexual assault in this case?
A. In fact, to come to a conclusion, that -- or not come to a conclusion, final conclusion.

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Q. All right. But even from the beginning of your work in this case, you knew that sexual assault was at least an issue, at least in the minds of the coroner and the district attorney, as presented to you?
A. Not only from the paperwork, Counselor, but also from telephonic communication from the County Coroner, Medical Examiner, Investigator.
Q. You did conduct an autopsy on Miss Britt; is that correct?
A. I did, Counselor.
Q. And in the report, there's no mention of a sexual battery on this child; is that correct?
A. That is correct.
Q. And why is that not listed as something in your final report of autopsy?
A. I could not come to a final conclusion as to that, Counselor.
Q. Okay.
A. There was one injury that I indicated would be consistent with the penetration of the anal area, but that, in and of itself, I didn't feel was enough to come to a conclusion that there was a sexual assault in this particular death.
Q. Okay. When you did your autopsy, you were

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not able to find any tearing of the anal area on this child; is that right?
A. No, there was not.
Q. If that is something that you had noted or found, then would you have noted it in your report, correct?
A. I would have.
Q. And you also would have had photographs that would have shown that on this child, correct?
A. I would have.
Q. All right. And it's mentioned -- sexual assault or battery is not mentioned anywhere in this report; is that correct?
A. No, I did not see evidence of that, Counselor. I was asked in court, but I did not see evidence in the autopsy, and, therefore, did not reflect it in the report.
Q. You did find a one-centimeter contusion; is that correct?
A. That's correct.
Q. Just for the record, how big is a one-centimeter contusion?
A. Approximately like that, Counselor.
Q. Okay. Now, but that was not listed in the list on the autopsy report as a traumatic injury; is

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that correct?
A. It wasn't, but it was listed in the body of the report, and also in the illustration body diagram.
Q. In other words, you noted it in your report, but did not list it as a traumatic injury to this child?
A. That's correct.
Q. And is that because there could be many possible alternative causes for a contusion such as this found on this child?
A. It's probably a typo error, Counselor, because I'm sure I dictated it, but the typist skipped it.
Q. All right. The photographs we mentioned didn't show any tearing; is that correct?
A. That is correct.
Q. All right. And, further, no tearing was listed or noted in the autopsy report?
A. No lacerations or abrasions were identified, only a single contusion.
Q. In this case, Dr. Hayne, you had prepared earlier a declaration. Have you had an opportunity to look at that?
A. I have.
MR. JICKA: I'm going to mark this, Pat, as

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the next numbered exhibit to Dr. Hayne's deposition, which will be Exhibit 3.
(Exhibit 3 marked.)
BY MR. JICKA:
Q. Dr. Hayne, were you able to review this declaration and correct it for any errors prior to executing it on March 5th, 2009?
A. Well, sir, I'm looking to see if I can find in my file here what you're addressing.
Q. I've got an extra copy.
A. Thank you.
Q. In this declaration, Dr. Hayne, it, first of all, involves your work and your opinions in the Jeffrey Havard matter, correct?
A. That's true.
Q. And you state, again, and forgive me, Pat, I'm going to try not to be too redundant on this in this deposition today, but, in there, you state that you found no tears -- this is in paragraph seven, Dr. Hayne.
A. Yes, sir.
Q. No tears to the rectum, anus, anal sphincter or perineum; is that correct?
A. That's correct.
Q. And it's not possible that tears would

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healed between the time that Miss Britt was seen in the emergency room and that you performed the autopsy?
A. They would not.
Q. I want to ask a little bit about this area of the human body. Do you agree that there's a delicate tissue lining of the anus rectum that can be damaged easily in a child of this age?
A. It can. It is a squamous mucosa lining, not skin.
Q. Okay.
A. And that is more easily injured, traumatized, than skin surface.
Q. And an injury can occur in a child like this, even by the application of a rectal thermometer; is that correct?
A. That could happen, but, Counselor, I think that would be highly unlikely to see an injury of such size as secondary to the placement of a thermometer by medical personnel.
Q. Okay. All right. And in reviewing the medical records, did you see where her temperature was taken by rectal thermometer on multiple occasions while she was in the emergency room?
A. I did see that, sir.
Q. As part of the final autopsy report, there's

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also a mention of a sexual assault kit.
A. An RSVK 1111 kit was employed to collect evidence that was subsequently submitted to the Mississippi Crime Lab under chain of custody.
Q. And as part of your work here, and as a result of the sexual assault kit, isn't it true that there was no semen found after a serological evaluation conducted on this child?
A. Actually, by microscopic examination, but no spermatozoa were identified.
Q. Okay. And swabs -- I guess what happens is that you will take swabs from different areas of the child's anatomy; is that correct?
A. That's correct.
Q. And then you will look under a microscope for any evidence that there might be sperm; is that correct?
A. That's correct. We look both oral, anal, and vaginal.
Q. And on this, it looks like, from the oral swab, the vaginal, and the rectal swab, that there was no evidence found of spermatozoa; is that correct?
A. That's correct. There are additional tests that can be performed, serological tests, and I believe those were performed, too, and they were also

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negative.
Q. Okay. And the serological evaluation was done with -- from an oral standpoint, a vulvar standpoint, a vaginal standpoint, and a rectal standpoint; is that --
A. I believe that is correct, sir.
Q. Dr. Hayne, what are the signs of brain death or lack of brain function in a child like this?
A. If you have brain death, first, there would be flaccidness. There would be unconsciousness. There would be muscle relaxation. There would be lack of breathing, unless there was artificial respiration being delivered. Body functions would essentially cease, either at that time or shortly thereafter. Eventually, there would be breakdown in tissue, lytolisis, purification, and the like.
Q. Okay. Reviewing the medical records for Miss Britt, I noted certain things, and I want to just mention and ask if these are signs or could be signs of lack of brain function, some of which you've already mentioned. Dilated pupils, sir?
A. That would be.
Q. Fixed pupils?
A. That would be.
Q. Lack of muscle tone?

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A. That would be, also.
Q. Asystole?
A. Asystole?
Q. Asystole, thank you.
A. Yes. That would be if the heart is no longer functioning. You can have brain death and still have functioning of the heart. Cardiovascular functionality could remain for a period of time, and respiratory could for a period of time, too.
MR. McNAMARA: I would have to interject and object at this time based on this is outside the scope of what we're here for as far as the sexual assault goes, without it being tied together as it is, and I would object to the continuing leading of the witness.
MR. JICKA: Okay. And I'll -- I will try not to lead. Dr. Hayne has a kind of interesting position in this case, so I'm not sure exactly what witness he would be considered by the Court, but I'll -- I don't mind asking nonleading questions.
A. May I interject one part to my -- one last part to my answer?
BY MR. JICKA:
Q. Sure.
A. There are many definitions of death. It could be cardiovascular, respiratory, central ne[illegible]

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system, somatic, cellular, and they all vary, you know, as to response of an individual.
Q. Based upon -- you've reviewed the medical records for Miss Britt in this case; is that correct?
A. I have, Counselor.
MR. JICKA: I'm going to mark those as Exhibit 4 to your deposition.
(Exhibit 4 marked.)
BY MR. JICKA:
Q. Based upon the information available to you, Dr. Hayne, was Chloe Britt brain dead or lacked brain function at the time that her anal dilation was first noted?
A. It was.
Q. And this was after she was successfully intubated; is that correct?
A. That's correct.
Q. And is this an opinion within a reasonable degree of medical certainty, sir?
A. As reflected in the medical record, yes.
Q. Okay. Do you commonly encounter dilated anal sphincters during a postmortem examination?
A. It can occur, but it's not as common as I think people think.
Q. Is that a recognized finding in the

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postmortem period?
A. It can be, yes.
Q. And do children who have died of brain injuries have an increased likelihood of having a dilated anus postmortem?
A. It's possible. I think you supplied me with one article from the Orange Journal, '97, "American Journal of Forensic Medicine and Pathology." In that particular article, there were 65 cases of which only a handful were involving children of less than one year of age, and of those --
MR. McNAMARA: I object again. This is not relevant to what we're speaking about. This is a general study. This is not the case that we're talking about.
BY MR. JICKA:
Q. Go ahead, sir.
A. And of all those, only one had suffered a traumatic death. In that particular case, the anus was described as slit-like. So in that case, there was no dilatation in a violent death that Dr. Lauridson is referring to in his opinion of 65 cases published in the Orange Journal.
MR. JICKA: And, Pat, I don't -- certainly I'm not dismissing your objection, but this goes

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directly to what we believe to be an issue in this case and allowed by Judge Starrett in his order.
BY MR. JICKA:
Q. Can resuscitation efforts result in a large amount of gas accumulating in the gastrointestinal tract?
A. Ineffective resuscitation, cardiopulmonary resuscitation. I do not believe that was the case in this particular individual, in that there was stool in the large bowel, and that would have effectively blocked the passage of air going down the gastrointestinal tract and dilating the distal part of the GI tract.
Q. So can this gas, the air and the amount of pressure on the bowel and colon, facilitate the passage of stool?
A. It's possible, yes, ineffective cardiopulmonary resuscitation.
Q. And isn't that what they had at the emergency room here, they had an ineffective CPR with this child?
A. It would only be my impression. They are medically-trained personnel to deliver cardiopulmonary resuscitation in an adequate manner.
Q. But this child was not revived at any point

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in time that you reviewed in the medical records?
A. No, sir, was not.
Q. Okay. If the gas enters into the colon, could that cause distention of the colon, and the rectum, and promote further dilation of the anus?
A. If that had occurred, yes sir. I saw no evidence of that occurring, but if -- in a general sense, if gas is pushing stool, it can dilate, pack the stool, enlarging the distal bowel, yes, it could do that.
Q. Okay. And could a spontaneous bowel movement also contribute to anal dilation?
A. Only if they're very hard stool would I expect to see that, if there's enough pressure with force with the chest or enema, you can -- even in cases of acute appendicitis, in patients that have survived. So that can occur, but that's pushing stool down into the space of the vermiform appendix, but I didn't see evidence of that in this particular case.
Q. If Chloe Britt was oxygen deprived for 45 minutes to an hour before the anal dilation, is it possible that she was -- was located, is it probable that she lacked brain function?
A. Forty-five minutes?
Q. Forty-five minutes to an hour?

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A. That would be reasonable that she would have been dead.
Q. Okay.
A. You can survive for a few minutes with oxygen deprivation, if it's total oxygen deprivation. The brain has a store of glucose and oxygen for approximately 15 to 30 seconds, then unconsciousness will commence, and shortly after that, within two to three minutes, death will intervene.
Q. In your autopsy report, Dr. Hayne, you note, several times, congestion. If you'll look -- you see on your finding, sir?
A. Yes, sir.
Q. Can congestion cause contusions?
A. No.
Q. Okay. The congestion that you found with Chloe Britt, where was it located?
A. It was in the viscera, the major organs. That's not to be unexpected. I don't think this death was an immediate death, and there would be a period of time, an agonal phase of death where the cardiovascular activity would be diminishing, pumping efficiency would also diminish, and blood would have a tendency to pool in the different organs, the lungs, spleen, kidneys, and the like, the liver.

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Q. The inner mucosa of rectum, is it sometimes visible after death in an autopsy?
A. It could be. It's unusual. You would have to spread the buttocks to look and see that.
Q. And what would it look like? Would it have a pink or red coloring to it?
A. Usually be a pinkish color, where there would be congestion, usually dependent from the geographic or the gravitational pull of blood downward.
Q. And if that inner mucosal lining was observed even by physicians, could it be confused as an anal injury?
A. I would think not, Counselor. I can't speak for them, but a contusion is usually fairly-well circumcised and outlined, while congestion would not be, but I would hate to speak for them.
Q. Okay. Flaccid, that's the same as limp; is that correct?
A. That's correct.
Q. Could a flaccid or limp muscle condition contribute to anal dilation?
A. That could, yes.
Q. Okay. And a dilated anal sphincter is not, on its own, evidence of anal sexual abuse; is that correct?

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A. It is not by itself, no.
Q. Okay. To determine that sexual abuse is a probability, you would need additional evidence than just the dilated anus; is this correct?
A. I would like to see more evidence as to traumatic injuries, also clinical history, and, hopefully, by laboratory testing.
Q. Okay. And we don't have here in your analysis, and your autopsy of Miss Britt, that additional type of evidence; is that correct?
A. Do not. I only have a contusion, which is a traumatic injury. We do not have abrasions, lacerations, presence of seminal fluid, spermatozoa, and the like.
Q. And, Dr. Hayne, can you say from your autopsy evidence, and from the coroner's inquest, the medical records that you reviewed, the photographs, and the laboratory findings, that this child, Miss Britt, was sexually assaulted?
A. I could not come to that final conclusion, Counselor. As I remember in trial testimony, I said that the contusion would be consistent with a sexual abuse, but I couldn't say that there was sexual abuse, and, basically, I deferred to the clinical examination conducted at the hospital.

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Q. And so from your standpoint and from your expertise, you cannot say that this child was sexually abused, to a reasonable degree of medical certainty; is that correct?
A. I could not now and I could not then, either; at the trial, or when I wrote the report, or discussed the case with the coroner.
Q. Okay. Is physical sexual abuse of a child a medical diagnosis?
A. Well, there's a component of a medical diagnosis. You're describing also a legal issue, too.
Q. Right.
A. The diagnosis could come from laboratory testing. It could come from physical exam by a treating physician. It could also come from a pathologist in a case where there's death, also from scene investigation. So it's a combination of things, but it's also a legal, and as you notice, I never used the term, "rape." That is a legal term, not a medical term.
Q. Yes, sir. Are you familiar with the expertise of the doctors and nurses that treated this child at the emergency room?
A. I'm not.
Q. Do you know --

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MR. McNAMARA: Object to anything along this line. The doctor has stated he is not familiar with their qualifications. He'd be completely incompetent to answer any questions regarding that.
BY MR. JICKA:
Q. Do you know what, if any, experience they had ever treating children that had had sexual abuse?
A. I don't know that, Counselor.
Q. Would you agree that it takes a certain medical expertise to determine whether a child has ever been sexually abused?
A. I would agree with that, yes.
Q. And in this case, from your work, hired by the State, you could not make a determination that sexual abuse was a probability in this case, correct?
A. I could not come to a final conclusion, Counselor. I could only come to the conclusion I so testified in court, that the contusion was consistent with what I've seen in a sexual abuse case. And also, just technically, I was contracted not with the State, but by the County.
Q. Thank you.
A. Adams County.
Q. And I appreciate it. Thank you for correcting that. Dr. Hayne, you testified at Jeffrey

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Havard's trial, correct?
A. I did, sir.
Q. And you were not asked, actually, about sexual battery during that trial, were you, sir?
A. Not specifically, no.
Q. But you were aware, from even from the coroner's permit, that that was an issue in the case, correct?
A. Oh, yes, and I knew before I even stepped on the witness stand that was going to be an issue.
Q. Okay. And prior to the trial, you discussed this with the district attorney whether you could say to a reasonable degree of medical certainty or even to a probability that sexual abuse occurred, correct?
A. That's correct. But all I could tell the district attorney, prior to trial, was that there was a contusion, and that would be consistent with sexual abuse, but I'd like to see more evidence before I made that next and more significant evaluation and conclusion.
Q. Okay. You -- if you had been asked the same questions we -- that I've been asking you today in court about sexual abuse, would you have answered them in the same manner, sir?
A. Exact way. I think I at least touched on

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some of those, and I have not changed my opinion, and it would make no difference whether defense or prosecution was asking me, the answer would be the same.
Q. That leads me to my next question. Did you ever meet with Gus Sermos or Robert Clark, Mr. Havard's attorneys about this case?
A. I don't remember that, Counselor, but I --
MR. McNAMARA: And I object. This is off the subject, not relevant.
BY MR. JICKA:
Q. If requested by them, would you have met with the attorneys for Mr. Havard in this case?
A. I always honor those requests, either prosecution or defense.
Q. And would you have answered their questions in a meeting the same way you have today, if asked?
A. If they were asking the same questions, I would respond the same way.
Q. Dr. Hayne, you can't say, or can you say, that Chloe Britt was sexually penetrated to a reasonable degree of medical certainty in this case?
A. I cannot. All I can say is the injury sustained would be consistent with that, but that's not a definitive diagnosis. And maybe I should

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explain.
Q. Sure.
A. I use a series of qualifiers, with reasonable medical certainty, I can say exclude, suggestive of, may fit, consistent with, and diagnostic of.
Q. Okay. Let's go off the record for a second. Let me review my notes and see what else I have.
A. Sure.
MR. MAGEE: Off the record. The time is 9:30.
(Recess.)
(Exhibit 5 marked.)
MR. MAGEE: Back on the record. The time is 9:40.
BY MR. JICKA:
Q. Dr. Hayne, thank you for helping me through this information today. What I'd like to do is show you what I've marked as Exhibit 5, and ask you if you can identify what that document is, sir?
A. This is a report from the Mississippi Crime Lab, their facility in Jackson, concerning samples that were collected. This would be -- appears to be from the hospital, including clothing, and then there's also a pillow case, and there's a purple-top tube of blood, and then it discusses the results

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the studies that --
MR. McNAMARA: I'll have to object. It sounds like the doctor is not familiar with this document.
MR. JICKA: All right.
BY MR. JICKA:
Q. Go ahead, sir.
A. And then remarks that some of the specimens were retained for DNA testing, also on an Eddie Walker. From an Eddie Walker, I should say.
Q. And, basically, in Exhibit 5, we have some results from a sexual assault evidence collection kit labeled Jeffrey Havard; is that correct?
A. Yes, sir.
Q. And in your work, are you familiar what makes up these sexual assault evidence collection kits?
A. I am, sir. We use them routinely.
Q. And what is that, sir?
A. RSVK 1111 kit, that would be for collection of saliva, collection of vaginal in fluid, rectal swabs, vaginal swabs, vulvar swabs, oral swabs, any clothing, hair samples, and the like, also, DNA tube of blood.
Q. And in all of the evidence that you had mentioned and that's shown here on Exhibit 5, was

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there any evidence or DNA connecting Jeffrey Havard with a sexual abuse of Miss -- of the child, Miss Britt?
A. In this particular one, I do not see evidence of that. This is basically clothing and other items involving the defendant and the decedent. This is not the material, that I can determine, that was submitted from the autopsy itself.
Q. So this would be additional materials that were tested with -- under the sexual assault evidence kit, in addition to the swabs that you've already testified about; is that correct?
A. That's correct. It indicates such items as clothes removed at Natchez Community Hospital.
MR. McNAMARA: And for the record, I continue to object. This is not a document that the doctor is familiar with or was generated by the doctor.
A. And fitted sheet beside a stove, and a used baby diaper, and items like that, Counselor.
BY MR. JICKA:
Q. Thank you, sir. All right. That's going to be Exhibit 5. Dr. Hayne, I usually start with this, but I guess I'll end at least your direct examination with this. We had noticed your deposition and asked you to bring anything that you had with you regarding

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this matter. What do you have in your possession involving this Jeffrey Havard matter, sir?
A. This is the complete file, and I also brought a tape. This the complete file that I have, Counselor.
MR. JICKA: Okay. Thank you, sir. All right. I'm going to make Exhibit 6 his notice of the videotaped deposition. All right. We will tender the witness, Pat.
(Exhibit 6 marked.)
EXAMINATION
BY MR. McNAMARA:
Q. Doctor, let's start off real quickly and just ask you, is your -- in your opinion, the testimony that you've given today, is it consistent with the testimony that you gave at trial?
A. It is, sir.
Q. Have you had any change of heart? Would you change your testimony?
A. I've seen no new facts to change my testimony, Counselor.
Q. Okay. I'll ask -- I have here -- have you seen the pictures you took at the autopsy --
A. Not since the trial, sir.
Q. -- in review? Okay. I'll pass you these

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three -- what I have here is a copy of the three, and we'll ask that that be substituted as an exhibit. And can you identify those pictures or do you recall those? They have your markings on there.
A. Yes, Counselor, I do recognize these.
(Exhibit 7 marked.)
BY MR. McNAMARA:
Q. Okay. One question I'd ask, as you see those injuries to the child's anus there, do you find that to be consistent with the insertion of a child's rectal thermometer?
A. I did not think that was an insertion injury from a rectal thermometer by medical personnel. I could not exclude it, but I think it was unlikely, Counselor.
Q. Okay. That is an abnormal anus, isn't it?
A. It is, Counselor.
Q. Did you -- to the question of the lack of semen or DNA evidence, is there a requirement that someone else's DNA or semen be present?
A. No, sir.
Q. They're just cause for penetration, is that correct?
A. That's correct, sir. It does not necessarily mean that a penis was the device used to penetrate.

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It could be some other object.
Q. There are several references throughout the trial, something about 12 o'clock, there was an injury at 12 o'clock of the anal area?
A. Yes, Counselor.
Q. Where exactly is 12 o'clock on that?
A. May I point, Counselor?
Q. That would be at the top, where --
A. Yes, Counselor.
Q. -- there's sort of a slender -- it's round in one area, and then it goes up and it's sort of slender?
A. That's correct, sir.
Q. Is that normal for a child to have that -- that wouldn't be a tear, that would just be -- what would that be?
A. For what?
Q. I'm sorry. The -- at 12 o'clock, it shows -- the pictures you're holding, there is a picture of the baby's anus?
A. That's correct.
Q. And it's rounded; is that correct?
A. It's elliptical.
Q. Well, toward the top of that 12 o'clock area, does it -- it peaks, it goes up, and comes to a point;

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is that -- that's how I'm looking at it.
A. Yeah, it points towards the perineum, yes.
Q. Is that indicative of that's not a tear, that would be just a stretch?
A. I did not see a tear, Counselor, no.
Q. What is that indicative of, that 12 o'clock injury?
A. There was dilatation at that site, Counselor.
Q. Okay. But it was dilatation of the entire anus, correct?
A. Yes, but more pronounced at that point.
Q. Okay. In describing that in your report, you say, on page 6 of your report, section F, gastrointestinal system, do you see that one? I'm sorry, I may be --
A. Yes.
Q. You've got it?
A. Yes.
Q. Is it says, "A section of anus reveals submucosal hemorrhage."
A. Yes.
Q. Where did you explain submucosal hemorrhage?
A. That is in the microscopic, "A section of anus reveals submucosal hemorrhage," yes, Counselor.
That would be the contusion.

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Q. And a contusion is?
A. Located at the point that I indicated to you.
Q. Okay. The definition of a contusion, what would that be?
A. Contusion is a tearing of blood vessels underneath the skin or mucosa with collection of blood at that site manifested by an area of discoloration, when one's looking at the injury, external to the injury itself. The lining, either the skin or mucosa, remains intact, and usually there's no bleeding on the skin or mucosal surface.
Q. Okay.
A. If one takes a microscopic section, you can see bleeding outside the vessels into the soft tissue, which would separate congestion from a traumatic injury, is a contusion.
Q. Okay. Final question, so -- being redundant, but you're saying, your testimony today is it's still consistent with what you testified to at trial, and you wouldn't change it?
A. No, sir. I would only change it if I saw additional information. And I'd like to point out, I did not come to a final conclusion.
Q. Okay. But you would agree with your testimony then that the injuries were consistent with

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an object being inserted or penetration?
MR. JICKA: Object to the form.
A. Yes, they were consistent with that.
MR. McNAMARA: That's all I have.
MR. JICKA: Just one second. Let's go off the record.
MR. MAGEE: Off the record. The time is 9:53.
(Recess.)
MR. MAGEE: This concludes the deposition. The time is 9:56.
(Whereupon the deposition was concluded at 9:56 a.m., the same day.)

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CERTIFICATE OF COURT REPORTER

I, Catherine M. White, C.S.R. and Notary Public, Hinds County, Mississippi, do hereby certify:

That on the 23rd day of November, 2010, there appeared before me, pursuant to notice and the Federal Rules of Civil Procedure, Dr. Steven Hayne as a witness in the above-mentioned cause;

That said witness was duly sworn by me to tell the whole truth, and nothing but the truth in said cause;

That counsel appeared on behalf of the respective parties as hereinbefore set forth;

That the foregoing deposition was taken by me by means of Stenograph machine and translated into transcript form by me, and that the foregoing 38 pages contain a full, true and correct transcription of the testimony of said witness;

That I am not in any way associated with any of the parties to said cause of action, or their counsel, and that I am not interested in the event hereof.

IN WITNESS WHEREOF, I have hereunto set my hand this the 29th day of November, 2010.

_____
Catherine M. White
CSR No. 1309
My Commission expires: 2/1/2014

Deposition of Dr. Steven Hayne

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Anthropomorphic simulations of falls, shakes, and inflicted impacts in infants

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Object. Rotational loading conditions have been shown to produce subdural hemorrhage and diffuse axonal injury. No experimental data are available with which to compare the rotational response of the head of an infant during accidental and inflicted head injuries. The authors sought to compare rotational deceleration sustained by the head among free falls, from different heights onto different surfaces, with those sustained during shaking and inflicted impact.

Methods. An anthropomorphic surrogate of a 1.5-month-old human infant was constructed and used to simulate falls from 0.3 m (1 ft), 0.9 m (3 ft), and 1.5 m (5 ft), as well as vigorous shaking and inflicted head impact. During falls, the surrogate experienced occipital contact against a concrete surface, carpet pad, or foam mattress. For shakes, investigators repeatedly shook the surrogate in an anteroposterior plane; inflicted impact was defined as the terminal portion of a vigorous shake, in which the surrogate's occiput made contact with a rigid or padded surface. Rotational velocity was recorded directly and the maximum (peak–peak) change in angular velocity ($\Delta\dot{\Theta}_{max}$) and the peak angular acceleration ($\ddot{\Theta}_{max}$) were calculated.

Analysis of variance revealed significant increases in the $\Delta\dot{\Theta}_{max}$ and $\ddot{\Theta}_{max}$ associated with falls onto harder surfaces and from higher heights. During inflicted impacts against rigid surfaces, the $\Delta\dot{\Theta}_{max}$ and $\ddot{\Theta}_{max}$ were significantly greater than those measured under all other conditions.

Conclusions. Vigorous shakes of this infant model produced rotational responses similar to those resulting from minor falls, but inflicted impacts produced responses that were significantly higher than even a 1.5-m fall onto concrete. Because larger accelerations are associated with an increasing likelihood of injury, the findings indicate that inflicted impacts against hard surfaces are more likely to be associated with inertial brain injuries than falls from a height less than 1.5 m or from shaking.

KEY WORDS • **brain injury** • **child abuse** • **diffuse axonal injury** • **subdural hematoma** • **children**

TRAUMATIC brain injury is the most common cause of death in children.[3] Brain injuries resulting in hospitalization or death occur in at least 150,000 children per year, at a rate of more than 200 per 100,000 children. Head injury in infancy results in higher incidences of morbidity and mortality than those seen in older children, and it has become increasingly clear that the significant incidence of nonaccidental injury in the youngest patients is, in large part, responsible for this difference.[5,11,28,29]

The majority of serious traumatic brain injuries in infants and toddlers is due to child abuse, and abused children with brain injury have a worse outcome than children who sustain an accidental brain injury.[5,13] The actual mechanism of injury responsible for subdural hemorrhage, retinal hemorrhage, axonal injury, and skeletal trauma that characterize abusive head injury has been debated for decades. Caffey[6,7] first proposed the term "whiplash shaken infant syndrome" to describe the occurrence of subdural and retinal hemorrhages in response to presumed inflicted angular acceleration of the head. Others have followed with reports of subdural hemorrhage, retinal hemorrhage, and death occurring in the absence of contact injury (skull fracture, cranial bruising, or scalp swelling).[2,20] Regardless, contact head trauma remains a frequent finding in abusive head injury.[17]

Accidental falls are also a common cause of trauma found in the pediatric population, with falls accounting for 25 to 34% of hospital admissions for pediatric trauma and 6% of deaths in children due to trauma.[21,34] Nevertheless, accidental falls are a common history given by caregivers in suspected abuse cases. The suspicion of abuse often arises when the event history appears not to correspond to the injury in the child. The differentiation between causes of accidental and abusive head injury is hindered by the controversy regarding fall heights associated with serious head injures in children. Evidence exists to support the hypothesis that short falls do not cause serious injury and the critical height for a fall to cause death is substantial (> 10 ft).[4,10,34,36,49,55] Simultaneously, however, others contend that relatively short falls can occasionally cause injuries associated with high mortality rates, such as SDHs, epidural hematomas, and skull fractures.[8,18,19,21,40,43,44,46,54] Because the mechanical responses experienced by the head and the in-

Abbreviations used in this paper: ANOVA = analysis of variance; DAI = diffuse axonal injury; SDH = subdural hematoma; TAI = traumatic axonal injury; Δt = duration of the maximum change in angular velocity; $\Delta\dot{\Theta}_{max}$ = maximum (peak–peak) change in angular velocity; $\ddot{\Theta}_{max}$ = peak angular acceleration.

TABLE 1

Comparison between body measurements in infant and surrogate

Body Measurement	Infant	Surrogate
head weight (kg)	0.77–0.87*	1.13
head circumference (transverse plane [cm])	39.5†	40.5
head height (inferior to superior [cm])	13.5†	12.6
head breadth (right to left [cm])	10.5†	11.4
head length (anterior to posterior [cm])	14.1†	12.6
distance from shoulder to top of head (cm)	14.7†	15.1
distance from axis of rotation (C5–6) to top of head (cm)	15.4‡	14.7
distance from axis of rotation (C5–6) to center of gravity of the head (cm)	9.5‡	9.2
distance from axis of rotation (C5–6) to base of skull (cm)	3.3*	4.5
distance from axis of rotation (C5–6) to transducers (cm)	not applicable	18.0
total body weight (kg)	3–4* 4.8§	4.83
breadth of shoulders (cm)	17.6†	17.8
head/body weight ratio	0.23* 0.24‖	0.23

* Weight of 1-month-old infant according to Duhaime, et al., 1987.

† Measurements obtained in an infant 0 to 3 months of age according to Schneider, et al.

‡ Distance according to Swishchuk.

§ Weight of average male or female 6-week-old infant according to Kuczmarski, et al.

‖ Ratio in a 6-week-old infant according to Jensen.

jury tolerances associated with shaking, shaking with impact, and falls have not yet been established, the differentiation between accidental and inflicted head injury is problematic. Objective information regarding these parameters is needed to determine if some circumstances are more hazardous than others during accidental and inflicted traumatic situations.

Previously, dolls that were anthropomorphically matched to human infants were shaken with and without impact;[12] investigators reported that during an inflicted impact the angular deceleration of the head is 45 times that observed during a vigorous shake, exceeding scaled thresholds for concussion, subdural hemorrhage, and DAI. In that study, however, the angular (rotational) motions were calculated on the assumption that there was a fixed center of rotation, and were not measured directly. Moreover, falls were not simulated, only inflicted shakes and impacts. In this study, we have created an improved anthropomorphic surrogate of a 1.5-month-old infant, and directly measured the rotational velocities experienced by the head of the surrogate during shakes, inflicted impacts, and short-distance falls. This research also extends that of previously published studies by examining the effect of different contact surfaces on the rotational response of the infant's head during both abusive and accidental injury scenarios. By comparing the responses, our findings are an important step toward distinguishing the potential for head injuries caused by rotational motion during contact and purely inertial events, and during accidental and inflicted injury scenarios.

Materials and Methods

Construction of the Anthropomorphic Dummy of an Infant

Head Design. A dummy was designed, constructed, modified, and improved to create a more biofidelic and durable anthropomorphic surrogate of a 1.5-month-old infant than that used previously. The head of a toy doll (L... Baby; JC Toys Group, Inc., Miami, FL) was used to represent the head of the anatomically correct 1.5-month-old anthropomorphic surrogate. Because the center of gravity and the majority of an infant's body mass are located in the head and torso, the distribution of the weight of the arms and legs of the infant were incorporated into the weight of the torso. The surrogate's total body weight, 4.8 kg (10.6 lb), was matched to that of a 1.5-month-old infant whose body weight lies within the 50th percentile.[25] Using previously reported measurements, the distributed masses of the head and body were adjusted to mimic those of 1.5-month-old infant by creating a head/total body weight ratio of 0.235[12,25] (1.13-kg head mass). The breadth, length, and width of the head were measured and are in good agreement with those obtained in a 0- to 3-month-old infant in the 50th percentile (Table 1).

Neck Design. One-month-old infants have very compliant necks with little muscle tone and control of head movement.[9] The weak flexor and extensor muscles of the neck allow a significant lag between the head and torso when raising the infant to a sitting position and lowering him or her back to a lying position.[9] The normal movement of the neck has been described in the context of qualitative neurological examinations and developmental assessments in children; however, no quantitative information is available on the biomechanics of the human infant neck. In light of the absence of detailed quantitative information about the kinematics of infant necks in the literature, we fashioned a hinged neck with negligible resistance for the dummy, as previously published.[12] In this way, measurements would reflect a worst-case scenario of no resistance provided by the neck, so that we could ascertain the greatest possible velocities and accelerations that can be generated by these mechanisms. One end of a heavy-duty stainless-steel strap hinge was rigidly attached to the skull material on the surrogate's head; the other end was rigidly attached to the torso. The hinge was used as the neck joint in the surrogate to allow resistance-free motion in extension and flexion with no movement in other directions. The center of rotation of the hinge was located 9.2 cm inferior to the center of the mass of the head, and corresponded to the junction between C-5 and C-6 measured by magnetic resonance imaging.[51] Although the fixed center of rotation in the dummy would result in an overestimation of rotational acceleration because the actual centers of rotation are likely to be higher in the cervical spine, the relatively short cervical spine, compared with the head size of a typical young infant, minimizes the influence of this idealization. Regardless, this simplification once again errs on the side of a worst-case scenario.

Skull and Scalp Material. Another design consideration was the representation of the stiff skull with a flexible scalp. Experiments were performed to determine appropriate "skull" and "scalp" materials to use in the construction of the dummy. The mechanical properties of the orthopedic-grade copolymer polypropylene (2.25 mm thick; American Plastics, Fort Worth, TX) were tested and determined to lie between those of infant skull and suture.[31,42] The plastic was heated and molded to the head of the surrogate and allowed to cool to room temperature. The instrumentation mounting bracket was attached securely to the skull, creating a rigid connection among the instrumentation, surrogate skull material, and head. A latex rubber material (Mold Builder [1.25 mm thick]; ETI, Fields Landing, CA) with properties similar to scalp[34,35,42] was used to cover the occipital portion of the polypropylene skull; this material remained adherent throughout the tests.

Head Instrumentation

An angular rate sensor (model ARS-01; ATA Sensors, Albuquerque, NM) was securely attached to the top of the dummy's head via a lightweight bracket, and was adjusted to measure rotations with an axis of rotation oriented perpendicular to the sagittal plane. This transducer location was selected to be remote from the impact site, so as not to damage the transducer in the impact and fall experiments. Any similar location on the head and transducer orientation would have yielded the same rotational velocity data. The velocity channel was sampled at 10,000 scans per second and filtered using a digital Butterworth low-pass filter (DADiSP/2000; DSP Develop-

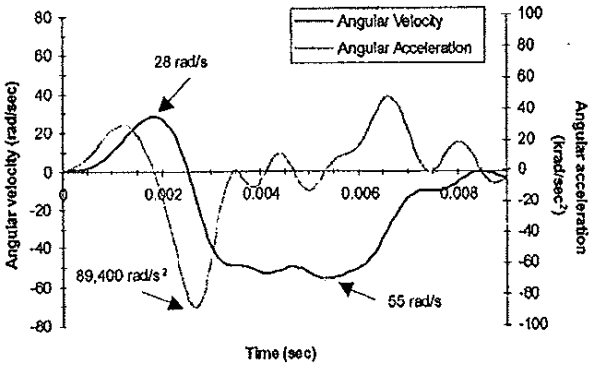

FIG. 1. Graph showing a representative angular velocity and acceleration trace for the impact produced from a 0.9-m (3-ft) fall onto concrete.

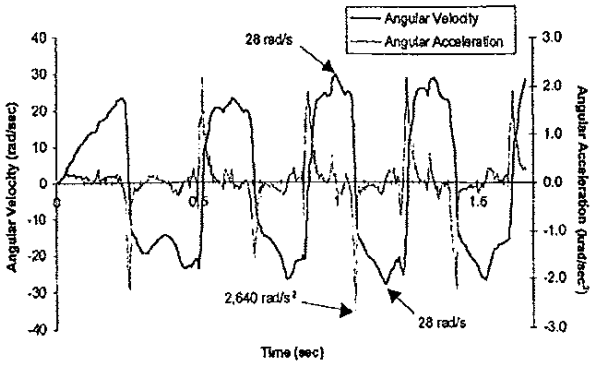

FIG. 2. Graph showing a representative angular velocity and acceleration trace for a shaking event.

ment Corp., Newton, MA) as specified by the Society of Automotive Engineers.[59] Simulations of falls and inflicted impacts that involved contacting hard materials (carpet pad, concrete, or lab bench) were processed through a low-pass filter with a cutoff frequency of 1000 Hz, according to the standard SAE J211-1 channel frequency Class 1000 used for measuring head accelerations during automotive crash tests.[59] Because shakes and impacts against the foam mattress had pulse durations much longer than impacts against hard surfaces, these signals were processed through a low-pass filter with a cutoff frequency of 250 Hz to eliminate the noise from the velocity signal.

Abuse and Accident Reconstruction

A custom-designed drop-test apparatus was constructed to allow the dummy to be dropped consistently from 0.3-m (1-ft), 0.9-m (3-ft), and 1.5-m (5-ft) heights. The surrogate was suspended supine from three points (two on the body, one on the head) with the height of the dummy's head placed slightly lower (< 3 cm) than the body to ensure that the surrogate's occiput was the first point to contact the surface. To reproduce the shaking of an infant, the surrogate was grasped firmly by its torso and held at chest level. The dummy was then shaken back and forth, making sure that during each shake the head went through a complete range of motion from full extension to full flexion. Each episode included at least five shakes, with the final shake concluding with an inflicted impact of the surrogate's occiput against one of three materials located at approximately the volunteer's waist level (0.9 m from floor). The sequence was divided into two segments, the "shaking event" and the "inflicted impact event," for analysis. Volunteers were instructed to use maximum effort during vigorous shaking and impact, and not to release or throw the dummy during impact.

Three materials were used in the fall and inflicted impact simulations: a piece of 10.2-cm (4-in)–thick foam from a crib mattress, a section of 6.35-mm (0.25-in)–thick carpet pad, and a hard surface (concrete floor for falls, stone bench top for inflicted impacts). These materials were tested and the average linear elastic moduli of the foam and carpet pad were measured and found to be 24.8 and 621 kPa, respectively,[42] whereas the elastic modulus of concrete in compression has been documented to range from approximately 20 to 60 GPa.[41] These data demonstrate the wide range of contact surface characteristics that were used in the household fall situations.

Statistical Analysis

After filtering the measured angular velocity for each event, angular acceleration was calculated by taking the derivative of the angular velocity–time history trace. Only the rotation caused by the initial impact was analyzed in traces for falls and inflicted impacts. For each shaking event, only the shake with the greatest angular acceleration was analyzed out of the series of shakes in the episode. Each event was analyzed to find the $\Delta\dot{\theta}_{max}$, the Δt, and the $\ddot{\theta}_{max}$ during this interval.

A total of 134 fall events were reconstructed from various heights onto different surfaces with at least 14 falls for each height–surface combination. A representative trace of the measured angular velocity and calculated angular acceleration during a fall is shown in Fig. 1.

Sixty-one shaking and impact sequences were performed by six different adult volunteers (four male and two female volunteers ranging in weight from 50–100 kg). Nearly all shaking episodes (60 of 61) consisted of a shake and an inflicted impact segment in which the surrogate's occiput made contact with one of three surfaces (foam in 18 episodes, carpet pad in 20 episodes, and a composite bench top in 22 episodes). Typical angular velocity and angular acceleration measurements from a series of shakes and inflicted impacts are shown in Figs. 2 and 3, respectively.

To determine overall differences between falls from different heights and onto different surfaces, three separate two-way ANOVAs were used to analyze the $\Delta\dot{\theta}_{max}$, $\ddot{\theta}_{max}$, and Δt individually. A Tukey test for multiple comparisons was also performed to determine the differences between each individual type of fall. The measurements from shakes were compared with inflicted impacts against different surfaces by using one-way ANOVA to determine the significance of the test mode and the Tukey test to determine differences between each pair of test modes. A Dunnet test for multiple comparisons to a control was used to compare the $\Delta\dot{\theta}_{max}$, $\ddot{\theta}_{max}$, and Δt from all falls, comparing the effects of the various surface materials by using shakes as the control or standard in the Dunnet test. The same analysis was repeated in a sequence of Dunnet tests by using inflicted impacts against foam, carpet pad, or bench top as the control group in each evaluation. Statistical significance was defined at a probability value of 0.05 or less for each analysis.

Results

Falls Onto Padded and Unpadded Surfaces

A two-way ANOVA revealed a significant overall increase in $\Delta\dot{\theta}_{max}$ and $\ddot{\theta}_{max}$ ($p < 0.001$; Fig. 4 *upper* and *center*) and a decrease in Δt with falls onto harder surfaces and from greater heights ($p < 0.001$; Fig. 4 *lower*). A Tukey test revealed no significant effect of the height of the fall in the measured $\Delta\dot{\theta}_{max}$ or $\ddot{\theta}_{max}$ during falls onto foam and showed that both kinematic measurements at a given height were significantly less for falls onto foam than for those onto carpet pad or concrete. Falls from a given height onto the carpet pad and concrete were indistinguishable, except for the $\ddot{\theta}_{max}$ during 1.5-m falls. For a particular surface, no significant difference between 0.9- and 1.5-m falls was found in the measurements of $\Delta\dot{\theta}_{max}$ or $\ddot{\theta}_{max}$; however, measurements of Δt were significantly different when comparing fall heights onto foam, with the Δt decreasing as the height of the fall increased.

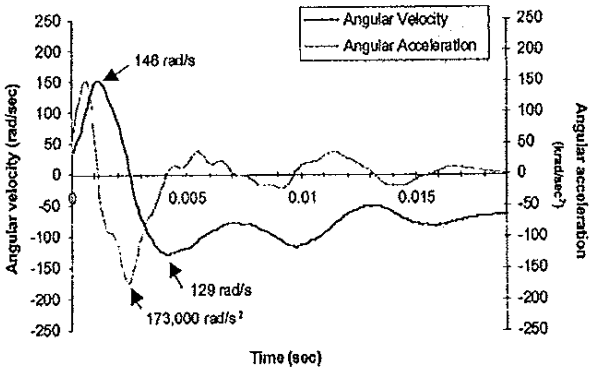

FIG. 3. Graph demonstrating representative angular velocity and acceleration trace for an inflicted impact against a bench top.

Shakes and Inflicted Impacts

Averaged across volunteers, the values of $\Delta\dot{\Theta}_{max}$ and $\ddot{\Theta}_{max}$ during inflicted impacts against foam were greater than, although not significantly different from, those measured during shaking events (Fig. 5 *upper* and *center*). Inflicted impacts against foam, however, had a significantly shorter average Δt than shaking events (Fig. 5 *lower*). Inflicted impacts against the carpet pad and rigid bench surface were indistinguishable. Taken together, inflicted impacts against these two hard surfaces resulted in an approximately 39 times greater $\ddot{\Theta}_{max}$, a three times greater $\Delta\dot{\Theta}_{max}$, and a 53 times shorter Δt than the response measured during shaking.

Shakes had a statistically similar $\Delta\dot{\Theta}_{max}$ to those of 0.3-m falls onto concrete and carpet pad, and a similar $\ddot{\Theta}_{max}$ to that of falls onto a foam mattress. Shaking resulted in a significantly longer Δt than any fall events. Inflicted impacts against foam had a similar $\ddot{\Theta}_{max}$ to that of falls onto a foam mattress and a similar $\Delta\dot{\Theta}_{max}$ to that of falls onto concrete. Inflicted impacts against a hard surface resulted in a similar Δt to those of falls onto carpet pad and concrete, and had a significantly greater $\Delta\dot{\Theta}_{max}$ and $\ddot{\Theta}_{max}$ than all fall scenarios.

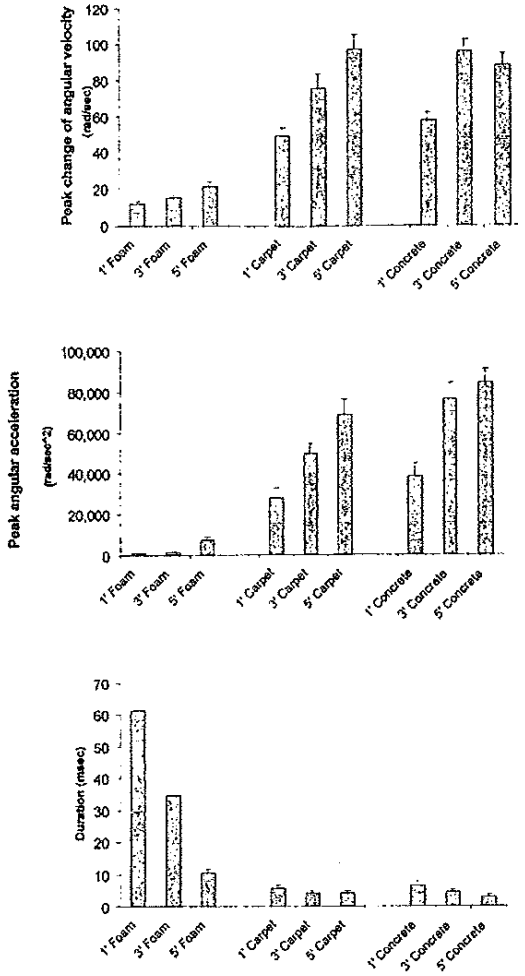

FIG. 4. Bar graphs showing the $\Delta\dot{\Theta}_{max}$ *(upper)*, $\ddot{\Theta}_{max}$ *(center)*, and Δt *(lower)* for falls from different heights onto different surfaces. The bars depict mean values and the error bars indicate standard errors.

Discussion

The focus of this study was to determine the rotational response of the head of an infant that is experienced during low-height falls and inflicted head injuries. Rotational motions have been shown to cause a diffuse pattern of strains and injury throughout the brain, whereas translational motion causes more focal damage.[37] For this reason, with the exception of epidural hematoma, falls have often been considered benign, because they are assumed to be essentially translational events. Nevertheless, although a fall may have predominantly translational components, its terminus (contact with an often immobile object) may produce significant rotational events and the brain may also experience rapid changes in rotational velocity and deceleration. It was the purpose of this study to measure these rotational events and to compare them with those created by shaking, impacts after free falls, and inflicted impacts.

In the impacts against carpet pad and concrete simulated in this study, the occiput made contact before the torso and then rotated, producing a significant angular motion of the head relative to the thorax. We found that the rotational accelerations and changes in rotational velocity experienced by the head during impact increased with the height of the fall. These larger rotational responses can be attributed to the higher linear velocities reached as drop height (and thus potential energy) increases. Harder surfaces absorb less energy than deformable materials during contact, causing the head to rebound more; the head thus experienced significantly larger rotational accelerations during contact with the concrete and the carpet pad, compared with contact with foam, during falls and inflicted impacts. Conversely, when the head contacted the foam it was pocketed in the foam, such that both torso and head moved together, producing only a very small rotational response. It should be emphasized that the foam material used in these tests was unencased, and the addition of a plastic or other covering might alter the deceleration pattern. For this reason, one cannot extrapolate tests performed using unencased foam to impacts against a covered mattress or padded furniture.

Anthropomorphic simulations

Head rotations during shakes occurred over significantly longer time periods than any other event. Thus, although shakes had a similar $\Delta\dot{\theta}_{max}$ to that of a 0.3-m (1-ft) fall onto concrete and carpet pad, this change in velocity occurred over a much longer period, producing a significantly lower $\ddot{\theta}_{max}$. Furthermore, shakes had a similar $\ddot{\theta}_{max}$ to that of falls onto the mattress foam, but because the Δt is longer, shakes had significantly higher $\Delta\dot{\theta}_{max}$ values.

There has been much debate on whether shaking alone is sufficient to cause the typical primary brain injuries seen in inflicted neurotrauma in infancy, specifically, SDH and/or TAI, or whether impact is necessary. Recent evidence suggests that injury to the cervicomedullary junction may be found in some cases of fatal inflicted head injury, and the role of this finding in the pathophysiology of apnea, hypoxia, and secondary cellular events is, at present, incompletely understood. Regardless, the focus of this study was to investigate the biomechanical causes of primary brain injuries by using rotational forces as a benchmark for the incidence of acute intracranial events such as failure of parasagittal bridging veins or axonal tears. To mimic inflicted impacts, the shaking scenarios described earlier were concluded with an impact of the surrogate's occiput against one of three surfaces. Our results demonstrate that measurements made during inflicted impacts against a carpet pad were not significantly different from those made during impacts against a rigid surface (lab bench top). Although the pad was less stiff than the bench top, the carpet pad used was only 6.35 mm (0.25 in) thick and the force of the inflicted impact completely compressed the pad during impact. During impact the carpet pad therefore exhibited the same properties as the underlying bench top during the later stages of contact. Inflicted impacts against carpet pad and bench top produced a significantly greater $\Delta\dot{\theta}_{max}$ and $\ddot{\theta}_{max}$ than those experienced under all other conditions simulated in this study. In contrast, the inflicted impact against the thicker (10-cm) foam mattress did not fully compress the foam, resulting in a $\Delta\dot{\theta}_{max}$ and $\ddot{\theta}_{max}$ that were lower than those associated with inflicted impacts against harder surfaces and similar to those associated with shaking. To summarize, inflicted impacts against the carpet pad and bench top had a three times greater $\Delta\dot{\theta}_{max}$ and a 39 times greater $\ddot{\theta}_{max}$ than shaking. These results suggest a higher likelihood of injury from inflicted impacts against hard surfaces than from vigorous shaking, or from falls of 1.5 m or less.

Sixteen years ago, we published results found using a less sophisticated anthropomorphic dummy of a 1-month-old infant,[12] and found similar $\Delta\dot{\theta}_{max}$ and $\ddot{\theta}_{max}$ ratios between shakes and impacts to those in the current study. In the current study, we constructed a more biofidelic 1.5-month-old dummy by using skull and scalp material with properties similar to those in infants. We measured rotational velocity directly and expanded the study to include falls and a wide variety of contact materials. Despite these improvements, the current study has several limitations. The dummy designed for this study included a simplified representation of the infant skull and neck that potentially influenced loads during falls and impact events. First, the dummy's skull was made from a solid homogeneous 2.25-mm-thick sheet of copolymer polypropylene. The actual braincase of an infant consists of bone plates connected by compliant sutures that allow substantial deformation of the skull. The compliant skull deforms during the birthing process and permits normal expansion of the brain and soft tissues during infancy and childhood; it also allows large changes in shape during impact loading.[31] These skull deformations would slow the period of contact during an impact, and decrease the resulting angular accelerations. The solid plastic "skull" of the dummy is therefore not an exact representation of the separate bone and suture material of an infant, and it could cause an overestimate of the response measured during impact events. Studies in [illegible] accurate skull and suture representations, which can also be used to measure skull contact forces, are now underway; the important data obtained in these studies will be crucial for computational simulations of skull and brain injuries caused by these focal loads experienced during impacts.

A second limitation of the current study is the inability of the surrogate's neck to mimic the properties of a real infant's neck. At present, no detailed quantitative information is available to validate the biomechanical properties of the human infant r[illegible]vely, as a child matures, the neck stiffness increases, [illegible]ing more resistance to a rotational motion of the head relative to the torso. Nevertheless,

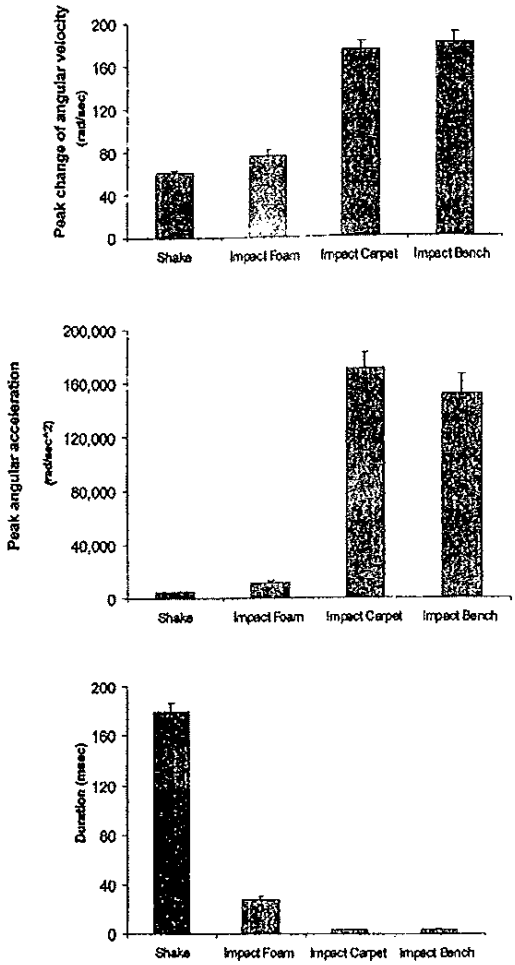

FIG. 5. Bar graphs showing the inflicted $\Delta\dot{\theta}_{max}$ *(upper)*, $\ddot{\theta}_{max}$ *(center)*, and Δt *(lower)* for shakes and impacts against different surfaces.

young infants (< 2 months old) have little muscle tone in their necks and cannot support the weight of their heads.[9] Thus, the low-resistance hinge representation may be appropriate for a newborn but not an older child. Furthermore, the cervical spine consists of a series of vertebrae, allowing for rotation of the neck in different locations and directions; the hinge used to model the neck motion in the dummy has a fixed point of rotation, only allowing anteroposterior flexion and extension. The hinge does not provide resistance to motion or dampen responses between the torso and neck. More accurate kinematics of the infant neck would allow for translation as well as rotation of the head, and a moving center of rotation. These differences in the kinematics of the neck result in an overestimation of the rotational motions experienced during falls and inflicted events. Although the biofidelity of the surrogate has not been established, these experiments do provide an upper boundary for the measured head response to shaking, inflicted impact, and falls. When data are available on properties of the neck, a more biofidelic model should be created to ensure accurate measurements during inflicted and accidental injury scenarios.

A third limitation of the study is that the model represents a child in the 50th percentile for body and head mass. A heavier child with the same neck development would experience higher impact energy in a fall or inflicted impact due to the larger mass, and likely would experience a concomitant larger rotational velocity and acceleration than a smaller child. It is difficult to speculate, however, whether the volunteers could have generated the same peak acceleration with a heavier child. Considering that each sequence was a maximum effort, it is likely that the shakes would have resulted in a lower acceleration and velocity in a heavier dummy. Thus we would anticipate a greater disparity among the data obtained during shakes, impacts, and falls with increasing body and head mass.

Subdural hematoma and TAI are among the most common findings in serious head injuries in infancy and in those associated with nonaccidental causes. Both these injury types have been produced by, and correlated to, the angular velocity or angular acceleration of the head.[1,15,16,32] Rotational motions have been shown to cause a diffuse pattern of strains and injury throughout the brain, whereas translational (linear) motion causes more focal damage.[24,37] Although the anthropomorphic dummy test data are useful to evaluate the rotational response of the head caused by falls and inflicted injury events, the results of the dummy tests cannot be used to predict whether such rotations are sufficient to cause injury. Regional tissue thresholds specific to the infant would be required to predict injury on the basis of local intracranial stresses or strains produced by the rapid rotations. Such thresholds are currently unavailable for the pediatric population. In lieu of this information, we used a more qualitative approach to determine injuries likely to occur during simulated events. Specifically, we correlated measured accelerations and changes in velocity with injuries documented from controlled cadaver, animal, and human experiments in which the response is often measured directly and the exact details of the injury event are carefully recorded. Using dimensional analysis, angular velocities and accelerations from the different animal, human, and cadaver experiments were scaled to the infant as a function of brain mass (420 g).[38] These results were compared with the different rotational responses measured in the minor fall and inflicted impact events simulated in the dummy experiments performed in this study.

Impacts from falls from 0.3, 0.9, and 1.5 m onto mattress foam, and from 0.3 m (1 ft) onto carpet pad produced the lowest rotational accelerations and changes in velocity of all falls examined in this study. Weber[54] found only a 10% chance of skull fracture when infant cadavers were dropped from a similar height onto a similar surface. No data have been collected from animal and human experiments that were conducted at the low levels of $\ddot{\Theta}_{max}$ and $\Delta\dot{\Theta}_{max}$ measured during falls onto foam. Values of $\ddot{\Theta}_{max}$ and $\Delta\dot{\Theta}_{max}$ similar to those measured during 0.3-m falls onto carpet pad were recorded from head rotations of instrumented models of boxers with no occurrence of concussion, skull fracture, SDH, or TAI of the brain.[39] All cases of SDH and DAI in human cadaver studies and primate (rhesus monkey and baboon) rotational inertial experiments[1,15,32] had considerably greater angular accelerations and velocities when scaled to a human infant than an average $\ddot{\Theta}_{max}$ and $\Delta\dot{\Theta}_{max}$ produced by falls onto foam. Correlating these experimental data, it is highly unlikely that serious or fatal injuries occur during falls onto an unencased foam mattress from a height of 1.5 m or less, or from 0.3 m falls onto a carpet pad.

At the rotational responses calculated during impacts after 0.3-m (1-ft) falls onto concrete and 0.9-m (3-ft) falls onto carpet pad, it is not clear if serious injuries occur. The experimental evidence shows both the absence and occurrence of serious head trauma. Specifically, although human infant cadaver drop test studies have demonstrated an 80 to 100% occurrence of skull fractures,[44,53] subhuman primate inertial studies[1,15,32] and adult cadaver studies[35] have shown both the presence and absence of intracranial hemorrhage and acute SDH.

No experimental data could be found with a $\ddot{\Theta}_{max}$ and $\Delta\dot{\Theta}_{max}$ similar to those of the most severe falls, that is, 1.5-m (5-ft) and 0.9-m (3-ft) falls onto concrete and 1.5 m (5 ft) falls onto carpet pad. At lower values of $\ddot{\Theta}_{max}$, however, impacts to the cadaver head caused intracranial bleeding, and nonhuman primates experienced SDH and DAI. The absence of data at this highest tier underscores our uncertainty regarding the occurrence of serious injury at these levels. These falls represent an extreme limit, producing the maximum rotation because of the hinge neck, the occipital contact site, and the purely sagittal rotation. In reality a fall is likely to include mixed rotational directions that would decrease the actual acceleration in the sagittal plane and the potential for SDH. For these idealized situations of falls onto hard surfaces, experimental data thus support at least the possibility of intracranial injuries caused by these most severe falls measured in this study.

There were no experimental data at values of $\ddot{\Theta}_{max}$ and $\Delta\dot{\Theta}_{max}$ similar to those measured during shaking or inflicted impacts against foam. For example, shakes and inflicted impacts against foam each had a $\Delta\dot{\Theta}_{max}$ similar to that associated with noninjurious head rotation in boxers,[39] but these human tests produced a significantly greater $\ddot{\Theta}_{max}$. The most severe inflicted impact against foam approached, but was still less than, the values of $\Delta\dot{\Theta}_{max}$ and $\ddot{\Theta}_{max}$ that produced SDH in adult rhesus monkeys and cadavers.[1,15,32] To summarize, there are no data demonstrating that the $\Delta\dot{\Theta}_{max}$ and $\ddot{\Theta}_{max}$ experienced during shaking and inflicted impact against foam cause SDH or TAI in infants.

Finally, although the $\ddot{\Theta}_{max}$ and $\Delta\dot{\Theta}_{max}$ measured during inflicted impacts against carpet pad and rigid bench top were significantly greater than those associated with all other scenarios tested in this study, no animal, human, or cadaver experiments at these levels of $\ddot{\Theta}_{max}$ have been published. The majority of inflicted impacts against these hard surfaces produced a $\Delta\dot{\Theta}_{max}$ and $\ddot{\Theta}_{max}$ greater than the scaled rotational responses that produced fatal acute SDH in adult primates and intracranial bleeding in adult cadavers.[1,15,35] Approximately half of these inflicted impacts also exceeded the scaled $\Delta\dot{\Theta}_{max}$ and $\ddot{\Theta}_{max}$ that produced axonal injury in adult baboons.[32] Given this experimental data, angular velocities and accelerations measured during inflicted impacts against hard surfaces would likely produce SDH and, possibly, TAI in an infant.

These injury projections should be interpreted with caution, because differences in species, age, material properties, geometry, and direction make scaling experimental angular acceleration and velocity measurements to infants problematic when based on differences in brain mass alone. To avoid the limitations of using scaled loads from animal and cadaver experiments to investigate real life events, case studies of minor falls in infants were also used to examine injuries that occur as a result of falling from different heights. Unfortunately, these falls are rarely witnessed, load measurements of the event are lacking, contact surface information is rarely given, and the population studied generally includes a broad age range, rather than just newborns. To increase the specificity of our comparisons, we included only case studies of children reported to be younger than 3 years old.

Skull fracture has been reported as a result of minor falls in children younger than 3 years.[11,18,19,23,27,47,52,55] Reports of falls 0.6 m or less note an absence of skull fracture.[44,48,53,55] Studies have documented cases of skull fracture from minor falls from heights estimated to be 0.9 m (3 ft)[18,19,47,52] and 1.2 to 1.5 m (4–5 ft)[55] with no fatalities. Importantly, several studies have also shown an increase in the risk of skull fracture with the increased hardness of surfaces contacted after a free fall.[27,54] To summarize, these case study data provide evidence that minor falls (< 1.5 m) can cause skull fracture, especially if the impact occurs on a hard surface.

Case studies of infants younger than 3 years old have shown that SDH, TAI, and death are rarely caused by impact from falls from 1.5 m (5 ft) or less. In a 3.5-year retrospective study, Chadwick and colleagues[8] found no fatalities resulting from 1.5- to 2.75-m (5–9-ft) falls. In that study the authors did find three to seven deaths in children younger than 3 years of age with a history of falling from approximately 0.6 to 1.2 m (2–4 ft), but the majority of these cases had associated injuries attributed to abuse. Cases of playground falls reported by Plunkett[40] revealed only six fatal falls ranging from 0.6 to 1.8 m during an 11.5-year period. The causes of death in all six children were determined to be SDH or cerebral edema. Studies of falls occurring in hospitals from an estimated height of 0.61 to 1.2 m (2–4 ft) do not show any case of SDH or death.[22,30,36] Other case studies have shown no incidence of SDH or death caused by falls from 0.9 m (3 ft).[48,55] To our knowledge, no case study contains a report of serious brain injuries or death caused by falls from 0.3 m (1 ft) or less. Similar to the results of the animal and cadaver experimental data, these data show that, although the possibility exits, SDH and death from minor falls are unlikely.

Conclusions

This paper presents the rotational response of the head of an infant, measured using an anthropomorphic dummy, during minor falls, shakes, and inflicted impacts. In general, the $\ddot{\Theta}_{max}$ and $\Delta\dot{\Theta}_{max}$ increased with increasing fall height and surface hardness. The measured angular velocity and acceleration during minor falls were similar to those associated with shaking; however, inflicted impacts against hard surfaces produced a significantly greater $\ddot{\Theta}_{max}$ and $\Delta\dot{\Theta}_{max}$ than a 1.5-m fall onto concrete. Because larger rotational acceleration and velocities are associated with a higher likelihood of injury, these findings suggest that inflicted impacts against hard surfaces may be more frequently associated with clinically significant inertial brain injuries than vigorous shaking or falls from less than 1.5 m. In addition, there are no data showing that the $\Delta\dot{\Theta}_{max}$ and $\ddot{\Theta}_{max}$ of the head experienced during shaking and inflicted impact against unencased foam is sufficient to cause SDHs or primary TAIs in an infant.

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